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Design of the Dictaphone

The Part Played by the Engineer

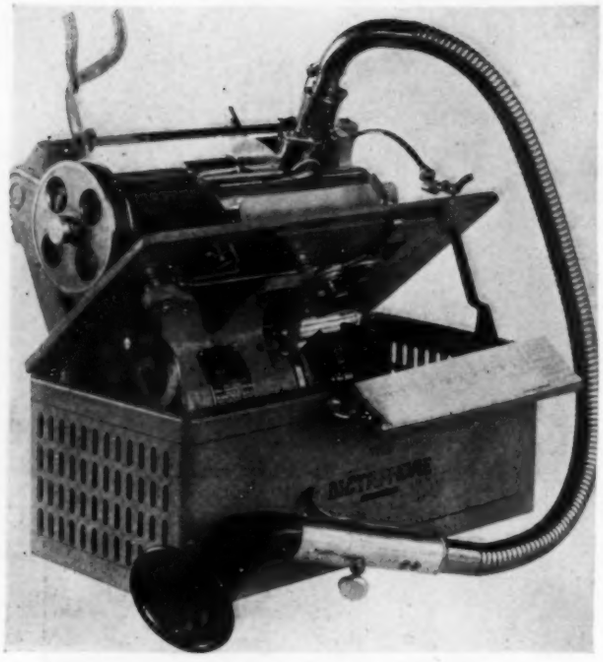
MAKING a machine, comparable to a fine jeweler's lathe, for operation by users who seldom have the least knowledge of fine tools, who understand nothing and care as little about the mechanism itself so long as it gives the desired results, is a job worthy of the most competent engineer. It is a tribute to engineering skill that many thousands of such machines are in constant and highly successful use today in nearly all parts of the civilized world. Such a result, in the case of the Dictaphone, has been realized in large part through refinements in design and extreme care in the construction, as well as in the correct selection and treatment of the materials employed.

The design and manufacture of a successful dictation machine involves the solution of more engineering problems than appear to a casual observer. Such a machine is, in reality, a small lathe driven at constant speed by a self-contained motor. This lathe must cut a thread of variable depth on a wax cylinder carried on a mandrel. The cutting "tool," although of microscopic size, must last, in general, for the life of the machine without replacement or resharpening. Yet the tool carrier is, of necessity, a sensitive diaphragm similar to that in a phonograph. This diaphragm must be mounted upon a carriage arranged to be moved forward by a lead screw of extremely fine pitch. These are but a few of the requirements.

Few people realize how much effort is needed or how diverse a knowledge of materials, or users' habits, and of possible causes of failure is required to plan, design and develop an intricate mechanism of this class. To make it commercially acceptable to executives as well as to their employees demands, of course, close co-operation between many individuals aside from those who do the engineering work. Without the engineer, however, such machines as the modern Dictaphone never would have been created, much less have found the widespread use they now enjoy.

This introduction to an engineer's description of the Dictaphone and the reasons behind its design is written, therefore, to acknowledge commendable engineering accomplishments, thereby giving proper credit where credit is deserved.

L. C. Stowell
President, Dictaphone Corporation.



A modern dictation machine with frame casting tilted up to show the motor, cooling fan, driving mechanism, cylinder ejector and other parts

Dictation Machines

A STUDY IN INTRICATE MECHANISM

By THEODORE H. BEARD
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ANY ATTEMPT even to outline the engineering processes whereby the Dictaphone has been evolved over a period of nearly fifty years would require far more space than is available here. This article, therefore, deals chiefly with design features of a trio of machines which compose the Dictaphone "family" of today. These comprise a machine for recording dictation, another machine used by the typist in reproducing the dictation for transcription, and a third machine employed only for shaving record cylinders after their dictation has been transcribed, so that they may be used repeatedly for recording new dictation.

In both the dictation and reproducing machines the wax cylinder is carried on a mandrel the spindle of which runs in bronze bearings set into the cast-iron frame shown in accompanying cuts. This frame carries also the supports and bearings for the lead screw, the carriage, the driving mechanism, including the spring-supported motor, and practically all other mechanical parts of the machines. The cast frame is supported upon a box-like base formed from sheet steel and arranged to inclose the motor and other electrical units.

Gray cast iron, because of its rigidity, moderate cost,

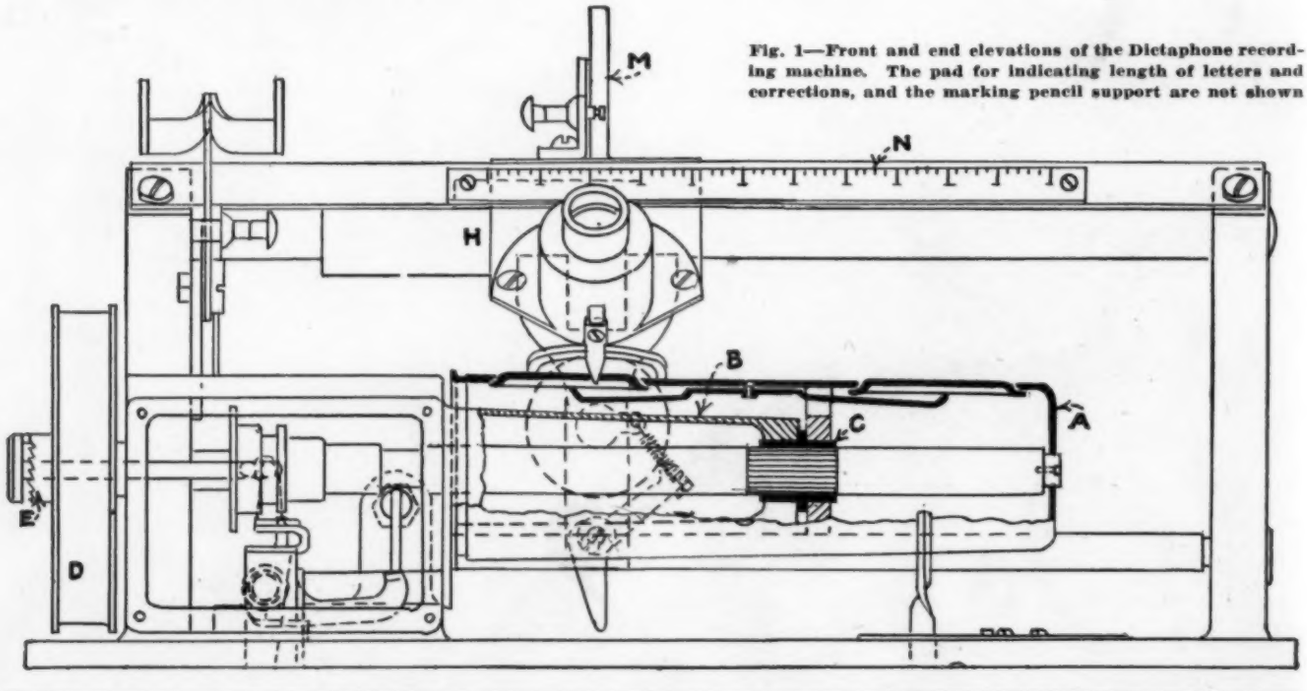


Fig. 1—Front and end elevations of the Dictaphone recording machine. The pad for indicating length of letters and corrections, and the marking pencil support are not shown

and adaptability to complicated shapes has proved to be an ideal material for the frame of all three machines. To assure a rigid support for the wax cylinder, which must run true within 0.001 in. two bronze bearings, spread as far apart as possible, as shown in Fig. 1, are used for the mandrel spindle.

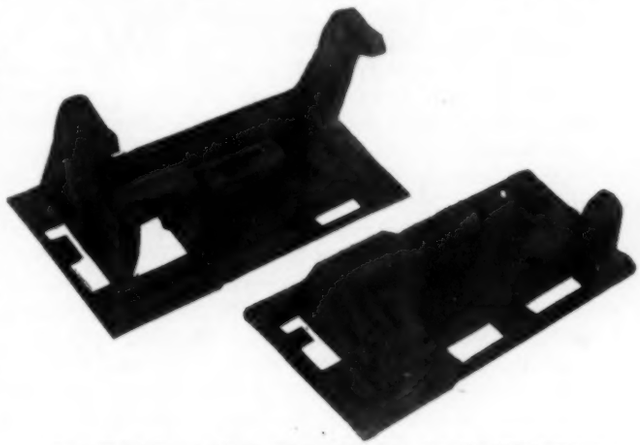
The mandrel *A* is made hollow and a horn *B* of the main frame casting projects inside the mandrel to about one-half its depth. In the end of this horn is inserted a bronze bushing *C*. The other mandrel bearing is a bronze bushing inserted into the main frame next to the overhanging pulley *D*. The pulley is loose on the mandrel shaft, but a tooth clutch *E* connects the pulley to the mandrel shaft when the machine is operated.

The feed screw is driven from the mandrel shaft by means of a train of gears. The intermediate gears are made from a Bakelite-impregnated composition to assure quietness. The feed screw is cut with extreme accuracy. It has a pitch of 64 threads per inch, which, with a gear step-up of 2½ to 1, moves the carriage along the cylinder at a rate such that the recording stylus cuts on the cylinder 160 hill-and-dale grooves per inch. Since the carriage is moved by the feed screw in only one direction, a buttress thread gives the best results. The carriage is fed from left to right only but can be moved back by hand by disengaging the feed nut and sliding the carriage to the left.

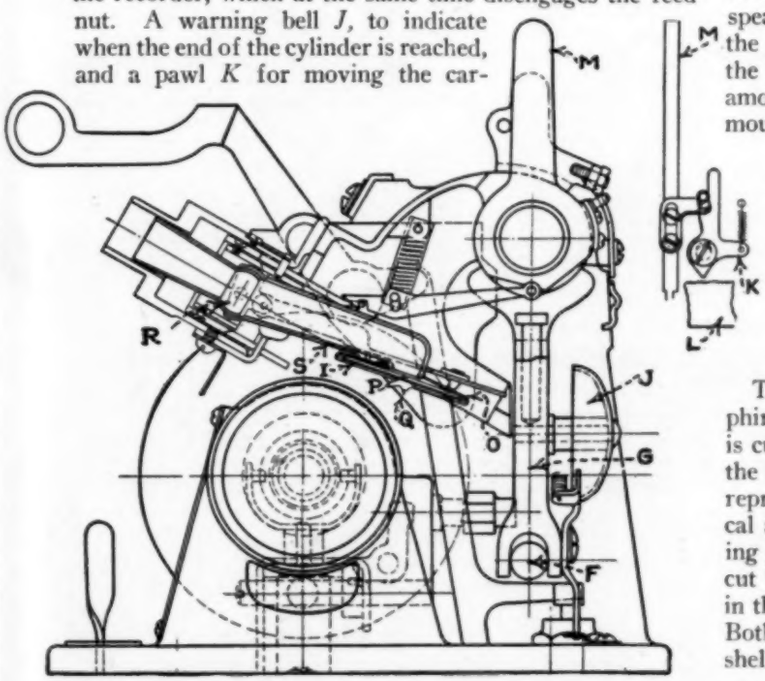
In the recording machine the feed screw is inside a tube having a slot cut through its under wall. The feed nut projects through this slot. The carriage, with the recorder, moves along the outer tube and is held in exact alignment with the feed screw by this means. A double half-nut engages the feed screw and drives the carriage. This nut is held in contact with the feed screw by means of a coiled spring. The carriage is further guided and adjusted for angle by means of an eccentric rod *F*, Fig. 1, which engages in a slot on a projecting arm *G* of the carriage *H*.

Because of its complicated shape, the carriage is a die casting. On this casting are mounted the recorder diaphragm *I*, and the mechanism for raising and lowering the recorder, which at the same time disengages the feed nut. A warning bell *J*, to indicate when the end of the cylinder is reached, and a pawl *K* for moving the carriage back when it is desired to listen to a portion of the previous dictation are also attached to the carriage. The pawl for back-spacing the carriage engages with a milled rack *L* which acts as the fulcrum for forcing back the carriage. This pawl is interconnected with the lever *M*, the lower end of which is connected with a linkage for positioning the recorder. When this lever is moved forward the feed nut is engaged and the recording stylus is brought into contact with the cylinder. When this lever is moved to the rear the carriage is back-spaced and a reproducing stylus engages the cylinder so that the dictator can listen to previous dictation. In its neutral position the lever *M* raises both stylii from the cylinder and disengages the carriage so that it can be slid in either direction by hand. A scale *N* on the front of the machine indicates at all times the position of the carriage with respect to the cylinder.

One of the vital parts of the dictation machine is the recorder. It consists of an aluminum pan *O*, carrying the mica diaphragm *I* to which are attached sapphire recording and reproducing jewels. When the dictator speaks into the mouthpiece, sound waves move down the speaking tube and impinge upon the diaphragm of the recorder. They deflect the diaphragm a varying amount according to their intensity. The sapphire stylus mounted on the diaphragm cuts a groove of varying depth in accordance with the deflection of the diaphragm. When the reproducing stylus travels along the groove previously cut it moves up and down over the hills and dales of the sound groove and by so doing deflects the diaphragm. The deflection of the diaphragm produces sound waves which are audible to the dictator when the mouthpiece is held to the ear, or even some distance from it when required.



Complicated gray-iron frame castings for the Dictaphone recorder (at left) and reproducer (at right). Some sections are only $\frac{1}{16}$ in. thick



The recording jewel *P* is a carefully lapped sapphire cylinder 0.020 in. in diameter and 0.10 in. long. It is cupped at one end to give a cutting edge regardless of the position in which it is inserted in its holder. The reproducing jewel *Q* is lapped so that one end is spherical and of smaller diameter than the cup on the recording jewel. This enables the ball-end to ride in the groove cut by the recording sapphire and follow the undulations in this groove without binding on the sides of the groove. Both jewels are set into the tiny aluminum holder with shellac. The various processes in their manufacture

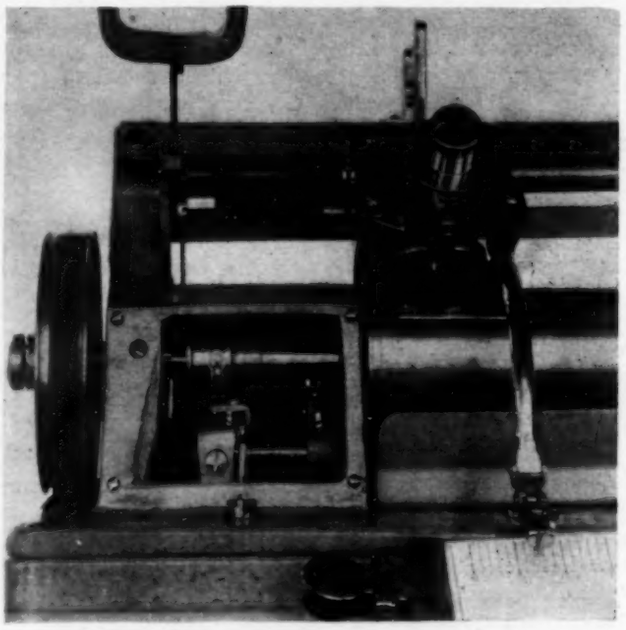
and assembly are carried out under microscopes to assure the required accuracy.

To insure freedom of motion to the diaphragm pan in a vertical plane and prevent side motion, the pan and tube assembly are mounted on two pivots. A ball joint *R* with its center between these pivots forms the connection between the aluminum tube *S* and the opening connected to the flexible tube which leads to the Pyralin mouthpiece. Pyralin is used because of its light weight, good sound transmission qualities, and relative freedom from accidental breakage. The weight of the aluminum pan *O*, diaphragm *I* and the jewel holder assembly rests upon the wax cylinder when speech is being recorded. When dictation is reproduced, however, a pivoted weight is allowed to rest upon the pan, thus giving it sufficient inertia to assure good reproduction. This weight is lifted free automatically when the lever *M* is shifted into recording position.

Power for driving the machine is supplied by a small series motor designed and built especially for the purpose, to operate on any circuit from 25 to 250 volts, d.c. or 65 to 250 volts, a.c. and cycles from 25 to 133. This motor has a small flyball governor which controls the speed by alternately applying friction pads to and withdrawing them from a disk on the armature shaft. A fan, mounted upon the same shaft, circulates air over the motor and the resistance unit, which is set to regulate the voltage applied to the motor. This motor is balanced carefully and is supported by springs.

The drive from the motor to the loose pulley *D* is by belt which is kept taut by a light wooden spring-loaded idler. The belt also prevents transmission of vibration. Removal of the mouthpiece from its hook automatically closes the motor circuit. The motor continues to run as long as the mouthpiece is off the hook, but the machine operates only when the clutch *E* is engaged. Engagement occurs the instant that the single tooth of the outer clutch half meshes with the teeth of the inner half.

It has been found advantageous to use a warning buzzer, functioning prior to the operation of the machine, to indicate whether or not the recording stylus is in position for dictation, for if the user dictates when the recording stylus is off the cylinder and the reproducing stylus is down, or when both stylii are off the cylinder, no dictation will be recorded. The small electric buzzer is cut in across the brush leads of the recording machine motor and is so interconnected with the Bowden wire that it does not function when the parts are in correct position for dictation. If, however, the speaking tube is lifted from the automatic switch hook with the reproducer in either the neutral or listen position, the buzzer sounds and continues sounding until the recording stylus is lowered into recording position, or until the clutch is thrown in to start the machine. It is undesirable of course to have the buzzer operating when listening back to previous dictation. A person desiring to listen back hears the buzzer until he presses the thumb button, and



Close-up of recording machine, showing details of the clutch mechanism, recorded diaphragm, scale marker and other parts

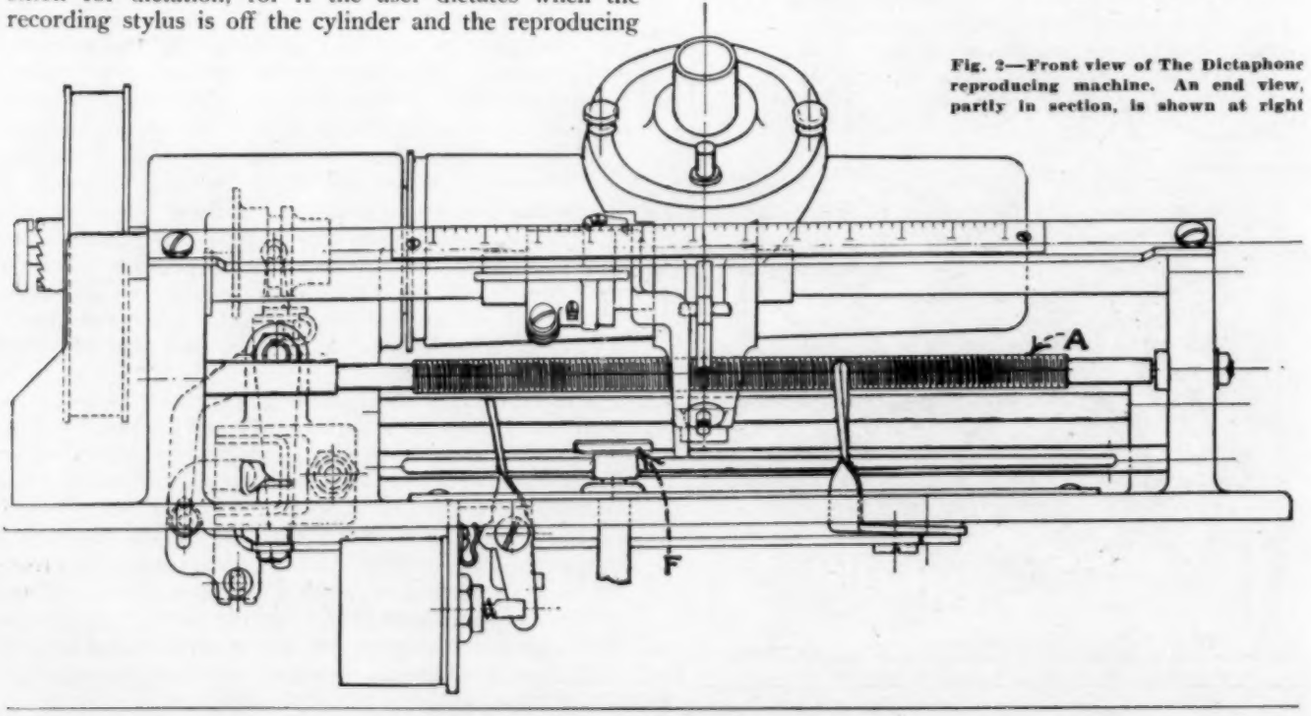
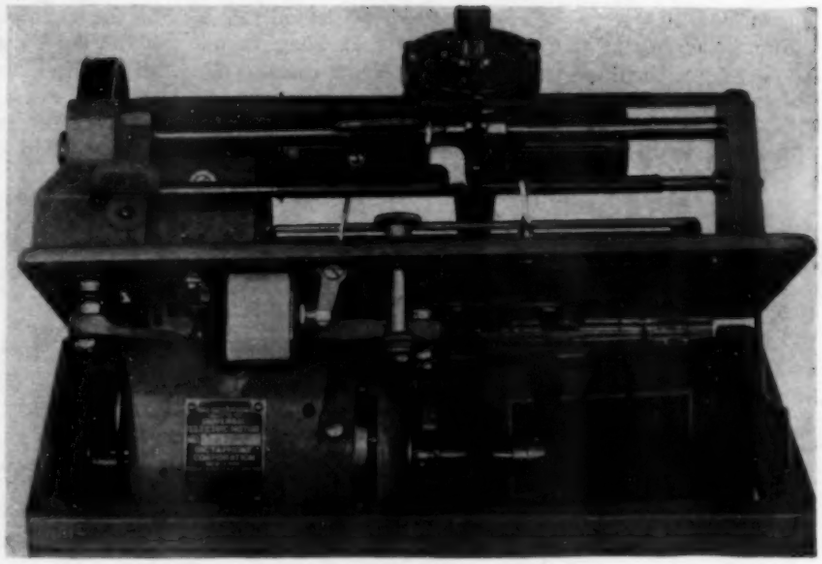


Fig. 2—Front view of The Dictaphone reproducing machine. An end view, partly in section, is shown at right

thus operates the machine, whereupon the buzz ceases. As soon as he releases the thumb, thereby stopping the machine, the buzzer starts once more, warning him to shift the lever M into proper position for recording before continuing dictation.

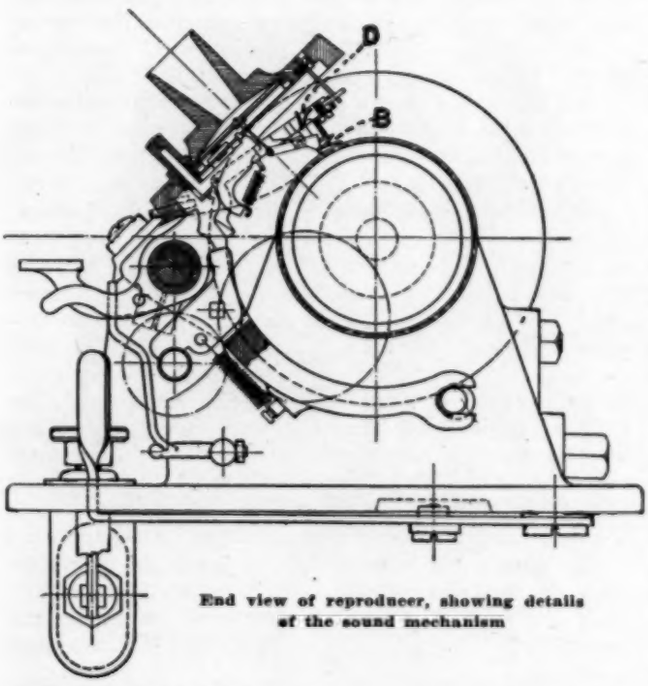
Sometimes it is necessary to make corrections, to indicate an extra carbon, or to insert an additional paragraph. To facilitate this work, the carriage has attached to it a pointer which moves along a pad containing slips of paper on which is imprinted a duplicate of the scale on the scale-bar of the machine. The pointer has mounted at its end a pivoted indicator carrying a small piece of silver wire. The paper is made with a very mildly abrasive surface. By moving the pivoted end of the pointer the silver wire makes a mark on the sensitive paper at the exact point at which the typist needs to take note of the change or special instruction. Marks to the left indicate corrections and marks to the right indicate the length of letter.



Reproducing machine with frame tilted up to show various mechanical parts. The governor on the motor shaft and its adjusting mechanism are seen clearly. Near the lower right corner is the variable resistance unit for adapting the motor to use on circuits of different voltage

To prevent damage to the recording and reproducing stylii, the cylinder ejector of the dictation machine is locked except when the lever is in neutral position. The locking operation is accomplished by a hook under the main frame that engages a pin on the ejector lever. This hook is disengaged when the lever acts on a crank by means of a bail pivoted on the eccentric rod. This bail allows the lever to act in any carriage position. A cam arrangement releases the ejector lock only when the recorder is in neutral position.

When the dictation on any cylinder has been completed, the cylinder is transferred to the reproducing machine, which differs somewhat in appearance from the dictating machine. In place of the mouthpiece and speaking tube, it has a voice modulator and rubber tube connected with two ear pieces.



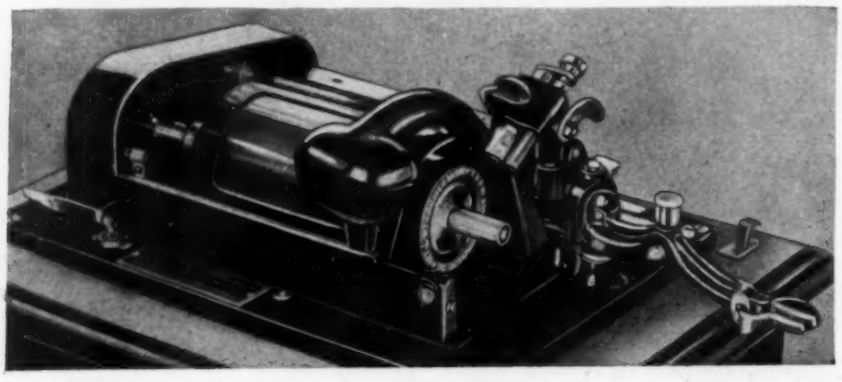
End view of reproducer, showing details of the sound mechanism

In general construction the reproducing machine resembles the recorder, but, because of its different function and the fact that it is used by a typist, requires certain alterations in the design and arrangement of some parts, as Fig. 2 clearly shows. In the reproducing machine it is necessary for the typist to be able to stop and start the machine easily and to back-space it so that dictation may be heard more than once if necessary. An open feed screw *A* of the same pitch as that used in the recording machine is mounted across the front of the machine. The motor on the reproducing machine is started by closing a switch on the main frame. The clutch is similar in construction to that used on the dictation machine, but is operated by compressed air, because the foot control employed is placed too far from the machine to assure satisfactory operation by Bowden wire. The back-spacing mechanism on the reproducing machine operates by means of a pawl and rack, but is capable of continuous operation. Movement of the back-spacing mechanism lifts the feed nut out of engagement with the feed screw, locks the reproducing mechanism to the carriage, after which the pawl back-spaces the carriage. The mechanism can be operated by the hand, or by means of an air cylinder which engages a lever with a pin on the pulley wheel. So long as the back-spacing foot control is pressed the back-spacer continues to operate, hence the typist can cause the reproducer to move back any desired distance without taking her hands from the typewriter keyboard.

Air pressure for the foot controls results from depressing the pistons in the foot control cylinders. The air pressure is transmitted through flexible rubber tubes to air pistons in cylinders attached to the main frame of the reproducing machine.

A number of differences between the recorder and reproducer mechanisms of the two machines will be noted by reference to the end views of these machines in Figs. 1 and 2. The transcriber sapphire stylus *B*, Fig. 2, has a ball point, and is carried on a small lever

hinged near its center and connected by a link to a minute fastening at the center of the mica diaphragm. The pivot for the lever is carried on a hinged member *D*, which is lifted when the carriage is back-spaced. A light rubber tube having a screw-controlled "throttle" valve conveys the sound from the diaphragm to a light headpiece with Pyrolin ear caps, or hearing tubes worn by the typist. In addition to varying the volume of sound transmitted, by adjusting the "throttle" valve referred to, the typist can vary the pitch by turning the hand screw *E*, thereby adjusting the governor, and consequently the speed of the motor.



Close-up of The Dictaphone shaving machine, believed to be the only lathe made for operation by unskilled users which automatically adjusts itself to making cuts of less than 0.001 in. in depth. The hinged end gate, which carries one of the two dead centers, is shown in its open position. The carriage and shaving knife are shown back of the right end of the cylinder. The curved arm above the cylinder is part of the carriage and has a foot resting upon a ground guide

The shaving machine is literally a lathe designed to take fine cuts from the surface of wax cylinders, and thus prepare them for re-use as many times as the wall thickness of the cylinder permits. Over 100 surfaces are available on the standard Dictaphone cylinder. Shaver manufacture requires great accuracy to assure parallelism of the carriage movement, and a true-running cylinder of uniform diameter. Since no definite relationship between the carriage feed and the mandrel is required, the feed screw of the shaver is belt driven. True running is assured by mounting the shaver mandrel on hardened male centers. The female centers are of hard bronze lapped to an accurate fit. Special fixtures are used to grind the rail on which the shaver carriage rests to assure a cylindrical turning operation without taper or eccentricity.

On the shaver carriage is an automatic device for setting and advancing the sapphire tool which removes the layer of wax, on which the sound grooves are engraved. Carriage movement tends to force the cylinder tighter onto the tapered mandrel. The tool holder carrying the sapphire shaving knife is attached to a set gage rod. The sapphire knife projects less 0.00025 in. beyond the set gage rod. With the carriage at the left end of the cylinder, and the knife beyond the end of the cylinder, the set gage rod is brought down until it touches the cylinder surface, and then the mechanism is locked. The carriage then is lifted and moved to the right end of the cylinder, and is lowered so that the feed nut engages the feed screw. When fed across the cylinder, the knife takes a cut equal to its lead over the set gage rod. When the first cut is completed, the carriage is lifted, and again this movement automatically advances the knife a fraction of a thousandth of an inch further for the finishing cut. The first cut ordinarily removes all the old dictation, and the second cut gives a perfect finish. An extremely smooth finish is essential to prevent "surface" noise in reproduction.

Choice of material which goes into the construction of the machines described naturally has an important bearing upon satisfactory operation, as well as upon cost of manufacture. It is very desirable to have as little weight as possible for the person using the dictation machine to hold. Consequently the mouthpiece is made from Pyralin, and the hand grip from aluminum tubing. The tube connecting the speaking tube and the recorder formerly was made from a casting, but now is made from a bronze forging. The forging offers denser metal, free from blow holes, and consequently rejects have been reduced greatly. The recorder itself is made from aluminum to secure the necessary lightness. A diaphragm of mica is employed because it has good acoustic properties that are retained indefinitely.

Sapphire recording and reproducing points are chosen because it is essential that the life of these parts be practically indefinite, and the hardness of sapphire is second only to that of the diamond used to grind it. In the carriage of both the dictation and reproducing machines die-castings are employed on account of the adaptability of this process to making complicated forms of relatively thin section, and of the fact that comparatively little machine work is required to produce parts of good finish and satisfactory for nickel plating. The same applies to the pulley on the mandrel shaft. Feed screws are made from as free cutting a steel as is obtainable, since the fine pitch and micrometer accuracy necessary make it imperative to secure a clean thread. All bearings of the three machines are made from bronze. A small brass tube running from an oil hole in the frame casting to the bearing at the end of the horn inside the mandrel conveys oil to said bearing.

Experience has shown that accuracy of manufacture is essential to assure quietness in operation. In consequence Dictaphone drawings call for over twenty dimensions which must be held to 0.0005 in. or better. Grinding is used on such parts as armature shaft, mandrel shaft, carriage rod, and shaver centers. No other parts of the machine, however, demand such careful work as that required on the recording and reproducing jewels and the shaver knife. These parts are made from sapphire. They are cut and lapped with diamond dust, until the final cylindrical form of the stylii and the rectangular shape of the sapphire shaver knife are obtained. The knife is lapped and burnished until it is without any seration when examined under a microscope with a magnification of 100 diameters. The face of the knife is very slightly convex.

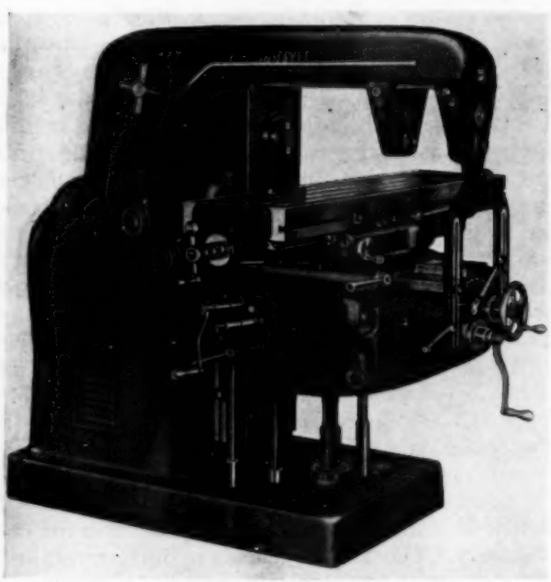
While many additional items could be added, the foregoing outline has been planned to cover the chief features of Dictaphone design. It is hoped that the summary given will prove useful to numerous engineers, and especially to those who may be faced with similar design problems.

ALUMINUM in Heavy Machinery

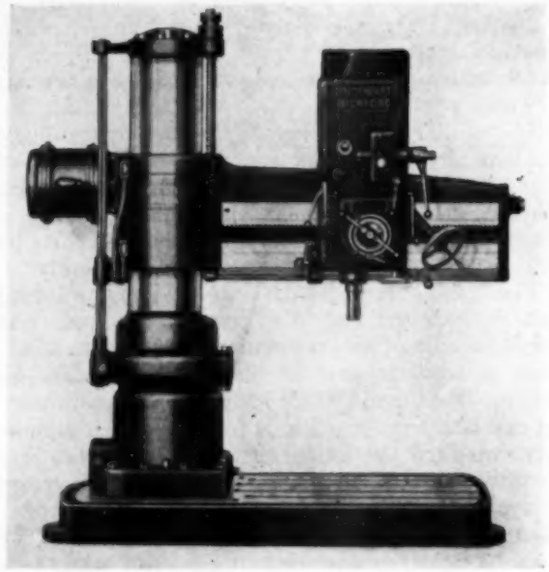
Modern tendency is towards lightness of construction. This article exemplifies the effects on costs, weight, and design, of the use of aluminum and light alloys in heavy machine tools

IS WEIGHT reduction an important factor in heavy machinery design? Formerly it was not considered so, but very recently there has been a decided shifting about of opinions on this subject. The first consideration is that machinery must be more mobile now than formerly. Seasonal changes in product design call for quick shifts in manufacturing machinery, often where heavy handling equipment is not available. An automobile plant, for example, is apt to make two complete rearrangements of machine layout per year.

Better understanding of vibration on the part of the designer has also changed his old ideas of massiveness and weight in his machine structures. Instead of "holding down" the vibrations by heavy weight in the machine and in the foundation he is reducing vibration by careful design, resulting in lighter machines that can be shifted readily from one foundation to another. Another factor that has turned the tables against weight and massiveness is the demand for high speed and quick starting and stopping and reversing. The inertia of moving parts must be kept down where high-speed flexibility is desired.



Arbor supports and gear case covers, which have to be removed frequently, are made of aluminum in order to secure lightness



Cover plates, brackets, and handwheels on the drillhead are made of aluminum, resulting in a saving of 370 lb. in weight

The airplane industry has unquestionably been the leader in pointing the way to lightness without loss of strength and rigidity, and most of the results of research on this problem in that industry can be carried directly into the field of general industrial machinery and metal products of all kinds. These results have been attained with the strong aluminum alloys, magnesium alloys, and with the super-strong special alloy steels.

What has already been accomplished in heavy machinery by the adoption of aluminum alloys is illustrated in a study recently made of the latest designs of three representative builders of machine tools. This investigation was made in the course of a field study by a supplier of the material, and the adoption of the light alloys by these companies has been found to have occurred largely within the last three years.

One of the companies selected as representating an important producer of large radial drills is now using approximately 130 lb. of aluminum sand castings in one of its radial drills, replacing about 500 lb. of cast iron. Most of the aluminum parts are being employed in the drill-head assembly. As shown in the accompanying picture of the drill press, this assembly slides back and forth on an overhanging arm, and in the extreme position may be located 10 ft. out from the center of the supporting columns. The elimination of the excess weight is of great importance when the head is at the extended position as it reduces the deflection in the arm.

The aluminum parts which go to make up this job are: five covers, each averaging 15 lb., six covers, averaging 2 lb., two brackets, averaging 22 lb., and two handwheels, averaging 2½ lb. Another advantage in the use of aluminum in the handwheel is the fact that it

lessens the flywheel action. The alloy used is an aluminum-copper-zinc-iron alloy, and costs 45 cents per pound, based on the best grade of individual wood patterns.

One of the leading manufacturers of grinders is putting aluminum sand-cast doors on its machines. These doors have average weights of only 4 lb. each, and are principally located in the base of the machine to give access to parts of the mechanism. Another aluminum part on this machine is the grinding-wheel cover. There is a total of approximately 75 lb. of aluminum on this machine, replacing 300 lb. of cast iron. Based on all-metal, match-plate pattern equipment, these castings cost 42 cents per pound.

The milling machine in the accompanying illustration has cast aluminum arbor supports and gear-case covers. The arbor supports average 15 lb. each and the gear-case covers about 55 lb. each. The chief advantage of the aluminum in both cases is the fact that the parts have to be removed from the machines quite frequently.

The large covers, on the basis of cope and drag pattern equipments, cost 37½ cents per pound. At this price the cost of the aluminum covers is practically the same as was the cost of the cast-iron covers because the aluminum castings are made very much thinner than the cast iron ones, in addition to the fact that aluminum is only one-third the weight of iron. The arbor supports are made of a copper-aluminum alloy, heat-treated, as strength is required. These castings made from high-grade pattern equipment cost 55 cents per pound. Though this cost is about twice that of cast-iron arbor supports, it is considered that the advantage of the saving in weight warrants it, particularly so, because the arbor supports must be handled quite frequently.

In the foregoing paragraph it was stated that the aluminum covers at 37½ cents per pound cost practically the same as the cast-iron covers they replace. It appears that in the machine-tool industry most of the work is of such heavy section that the cast-iron foundries do not ordinarily consider making castings less than ⅛ in. to ½ in. thick, even though the part could be made considerably thinner from a mechanical standpoint. Because the aluminum castings are designed to be considerably thinner, and because aluminum is so much lighter, the parts made of aluminum actually cost less than those made of cast iron in many cases. The lower cost of machining aluminum, as compared to cast iron, is also a factor.

Probably the most important prospective use of aluminum in the design of machine tools and equipment lies in the design of light alloy indexing heads. These indexing heads, in the case of large machines, weigh so much when made of cast iron that it requires several men or a block and tackle to move them. Even in the case of the largest milling machines, it is believed that by the use of aluminum indexing heads can be lightened to such an extent that one man can put one on and take it off. The parts of indexing heads are fairly highly stressed, and are therefore made of a copper-aluminum heat-treated alloy. Because of constant handling of the assembly, hardness is very desirable, and so far this has been the stumbling block in the design of these heads. Chromium-plated castings are now being tested. If this plating serves to reduce sufficiently the wear on the surfaces, it is believed that all difficulties will have been removed.

It is significant that one machine-tool builder increased his consumption of aluminum and aluminum alloys from 1,000 lb. in 1926 to 18,000 lb. in 1928. Other companies are probably also going along at this same rate in the substitution of aluminum and light alloys for cast iron.

Motorcoach Design Requirements

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SEVERAL outstanding requirements, the meeting of which has been proved by experience to be very desirable, exist for motorcoaches that are to be used on journeys of more than two or three hours duration. First in importance is comfort of the passengers. Reclining seats, have deep cushions, should be used. They should be simple in construction, light, amply strong, and the parts accessible to facilitate repairs. It is necessary to make the floor proof against the entrance of gas and dust. Lights should be of sufficient candlepower and so placed as to make reading in the coach easily possible.

Choice of the method of providing baggage space varies somewhat in different localities and with the design of vehicle; however, it is highly desirable that all baggage he carried inside the coach and under the owner's vision and supervision. The chassis and the body should be built into a single mechanical unit, thus saving weight and increasing the structural strength.

Better braking systems, with larger frictional areas and better air circulation to reduce frictional heat, are needed. Engines of at least 150 hp. should be used in the large motorcoaches. All chassis and mechanical parts should be made lighter and stronger than at present.

Certain coaches designed by the author have the entire power plant, including engine, transmission, clutch, gearshift, control levers, foot throttle, gages, instrument board, and fuel system assembled in a unit so arranged that it can be removed and another unit substituted by two men and the coach be ready for the road in 15 min. The front or rear axle, including the springs, can be changed in the same time. Springs have double main leaves and shackle pins to double the safety factor at these points. These springs are made on the two-stage principle to improve riding qualities. The driveshaft assembly can be replaced in 10 min. when the engine is out of the chassis.

Seats can be removed in a few seconds, and the upholstery covering or pads can be replaced almost instantly. All windows and glass are installed from the outside and can be replaced without entering the body, saving much labor. Body and chassis are built as one unit and entirely of metal. The main body-sheets are well fastened and form the inside body-panels. They need not be removed when making repairs to the outside of the body. The outside panels are the last installed and are the easiest to replace if damaged.

Condensed from a paper presented before the Transportation Meeting of the Society of Automotive Engineers, Toronto, Nov. 12, 1929.

Spline Milling Spindle Design

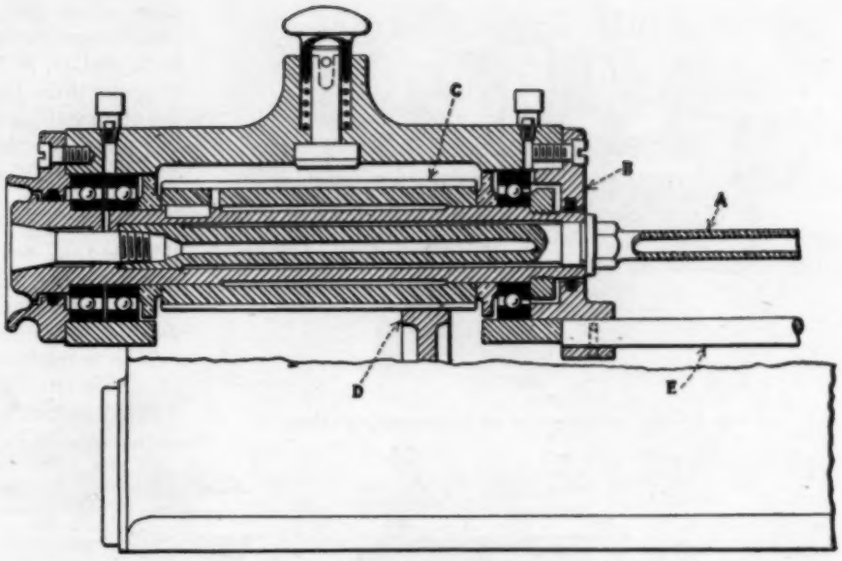


Fig. 1—Pre-loaded bearings and adjustable thrust collars are features of spindle design

By Fred A. Firnhaber
Machine Designer, Landis Machine Company

THE SPLINE miller is an example of a machine designed for a special purpose and afterward adapted to general use. Its origin is co-incident with the breech-loading rifle, where the double-spindle machine was designed to machine both sides of certain parts such as the lock bolt, in the same plane. A spline milling machine is primarily in the high-speed, light-cut field of slotting machines. It is not used as extensively as other types of slotting machines, but for quantity production of certain classes of of work, it is indispensable.

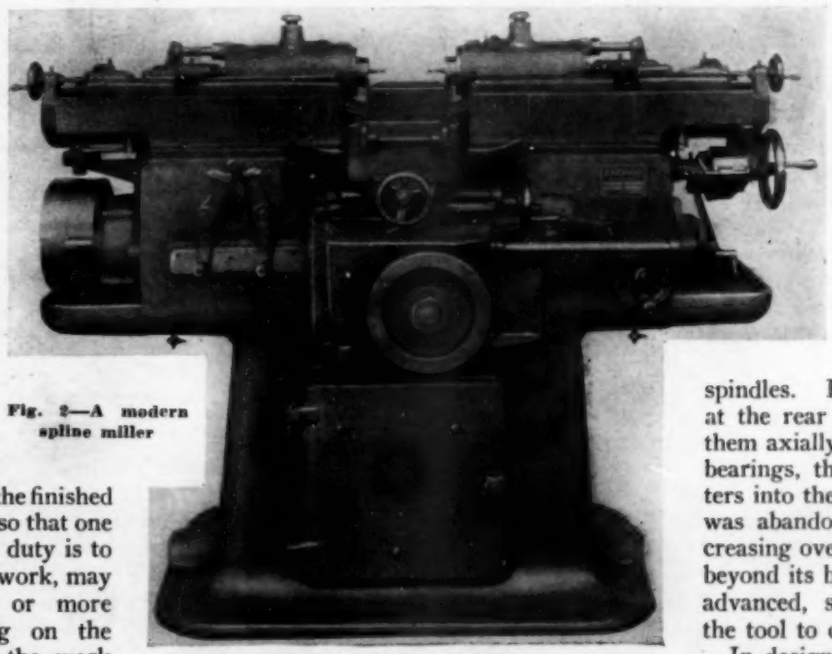


Fig. 2—A modern spline miller

Since its first appearance as a commercial machine, the spline miller has been greatly improved, both in the design of the machine and in the cutting tools used. The present machine is entirely automatic except the operation of clamping the work in the machine and taking off the finished piece. It is designed so that one operator, whose sole duty is to load and unload the work, may take care of one or more machines, depending on the size and nature of the work to be handled. The machine here illustrated can cut slots as wide as one inch. The maximum length of slot that can be cut in one pass of the table is the maximum stroke of the table, six inches in this case, plus the diameter of the cutters. Longer slots may be cut by using an auxiliary table clamped to the regular table, as will be described later. Single pieces up to five inches in diameter, or two pieces totalling not more than five inches in diameter, may be splined on this machine.

The front and plan views of this spline milling machine are shown in Fig. 2 and Fig. 3 respectively. The work holding fixtures are clamped on the reciprocating table whose motion is obtained through the roller barrel cam and arm. By means of a handwheel the stroke imparted by the arm may be adjusted up to a maximum of six inches.

Two cutters, directly opposite each other, are chucked in the sliding heads. These heads, by means of the right and left hand feedscrews operated by the feed mechanism, slide in long square gibbed ways, thus feeding the cutters into the work. In the earlier type of spline milling machine the cutters were chucked in spindles. Face cams mounted at the rear of the spindles slid them axially through their fixed bearings, thus feeding the cutters into the work. This design was abandoned because the increasing overhang of the spindle beyond its bearing, as the cutter advanced, sometimes permitted the tool to chatter.

In designing such a machine, or a splining attachment, it should be borne in mind that the utility of the machine is absolutely dependent upon the spindle, and, therefore, any design should begin with the spindle and the rest of the machine be built around it.

The design of the cutter spindle plays a very important

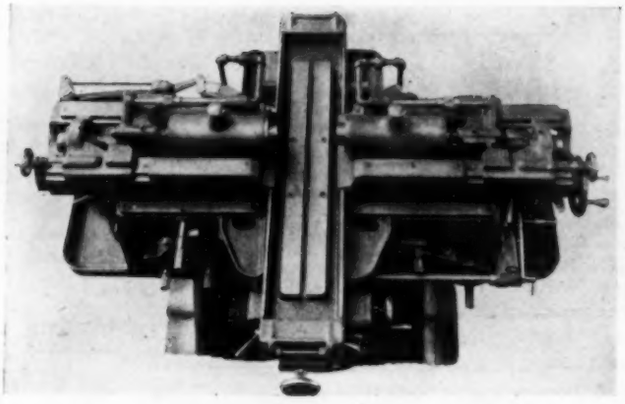


Fig. 3—The arrangement of table and spindles

part in spline milling, rigidity being required to prevent chatter. In the design shown in Fig. 1, the spindle proper is mounted on Gurney ball bearings, the two front ones being radial bearings, while the rear one is a combination radial and thrust bearing. The rear bearing receives the thrust on the cutter and transmits it through the flanged cover plate *B* to the spindle housing. A long pinion *C* is keyed to the spindle and is driven by gear *D*. This construction permits the gear and pinion to remain in mesh while the cutter head slides in the gibbed ways. The feed screw which moves the cutter head is not shown in the figure. It is located at the end of the shaft *E*. The drawback rod *A* is made hollow so that in addition to clamping the cutter, it also serves to feed the coolant to the cutting edge of the tool. Pressing down the knob on the top of the housing engages a tooth with the spindle pinion. This locks the spindle so that it cannot rotate when the drawback rod is being tightened or loosened.

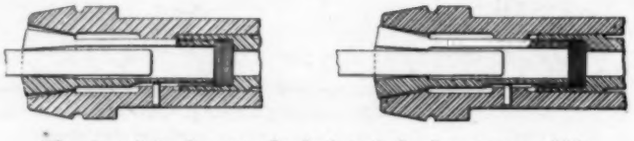


Fig. 4 and 5—Improperly designed chucks cause wabble and inaccuracy

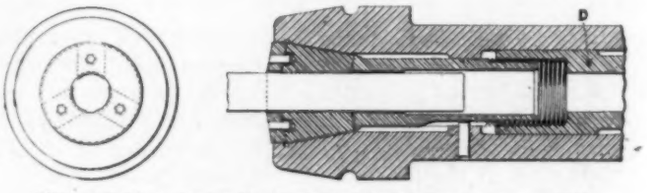
Next to the spindle, the design of the collet determines the efficiency of the machine, because it affects the accuracy and smoothness of the cut, as well as the maximum speed at which the cutter will operate satisfactorily.

In order that the cutter may be held rigidly, its chuck must be properly designed. In Fig. 4 is shown how an undersized cutter shank is gripped only at the front edge of the collet, when the chuck is improperly designed. If the cutter shank be oversize, it will be gripped only by the inner edge of the clamping jaws of the collet, as in Fig. 5, which is the same design of chuck as shown in Fig. 4. In both cases illustrated, the cutter has a tendency to wabble.

The design of a cutter chuck that will hold cutters rigidly, even if their shanks be somewhat over or under size, is shown in Fig. 6. In this design the spindle nose is ground to a taper of ten degrees per side. The three-jawed steel chuck is hardened and ground to make a mating fit in the nose of the spindle. The construction of this three-jawed chuck is shown in more detail in Figs. 7 and 8. The body of the chuck is bored a few thousandths larger than the diameter of the shank of the cutter. The three slots for the jaws are equal spaced, and milled perpendicular to the tapered surface. Retaining pins fit loosely in the jaws, and keep them in place when not in use. The jaws are ground all over and fit snugly in the chuck housing. When the drawback rod *D*, in Fig. 6, pulls the chuck into the spindle, only the three jaws clamp the shank of the cutter. It will be observed that, with this design, the jaw will clamp the shank of the cutter uniformly, regardless of slight variations in diameter.

Cutters with large diameter shanks may be chucked as shown in Fig. 9. The end of the cutter shank is threaded to fit the drawback rod. The flutes of the cutter extend beyond the shank, thus forming a shoulder which bears against the split collet shown in detail. The method of functioning is obvious.

The work-holding fixture shown in Fig. 10 is known as a vise and footstock. The vise has a large V-groove, located so that its center coincides with the center of the cutter spindle. The vise will accommodate work up to five inches in diameter. It is shown clamping a bar of small diameter. For the larger diameters, the clamp must be reversed. The vise is fastened to the machine table by T-head bolts fitting in the slots in the table. The dovetail in the base is to permit adjusting the vise on the machine



Figs. 4 and 5—Improperly designed chucks cause wabble to the cutter shank

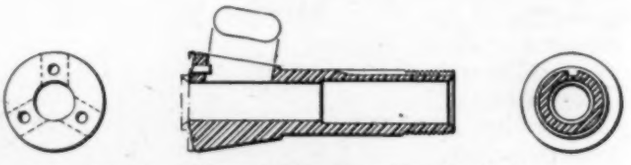


Fig. 7—Details of the self-conforming chuck

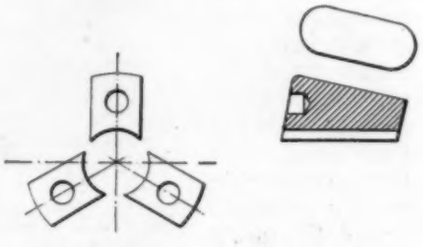


Fig. 8 — Hardened and ground jaws are fitted in the chuck body. Retaining pins keep them in place

table. The footstock is adjustable crosswise on its dovetailed base which is fastened to the table. A screw clamps it in position after it has been properly located. The footstock has a reversible combination center that can be used for either centered, or uncentered work. For very short jobs, the footstock need not be used. The portion of the work to be splined may be allowed to project beyond the vise. For very long work, or for holding two pieces at a time, two vises may be used.

When slots too long for the stroke of the machine are to be cut, an auxiliary table, such as shown in Fig. 11, must be used. The work is clamped in the fixture in the manner shown in the figure. The slot is cut from one

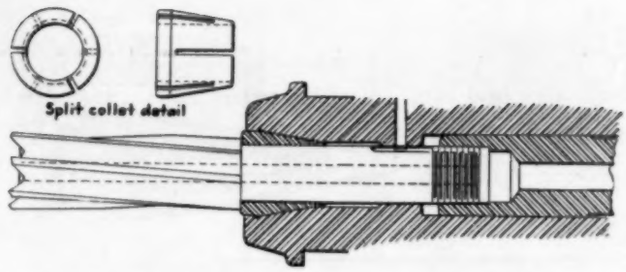


Fig. 9—This design permits the use of a short, split collet with large diameter shanks

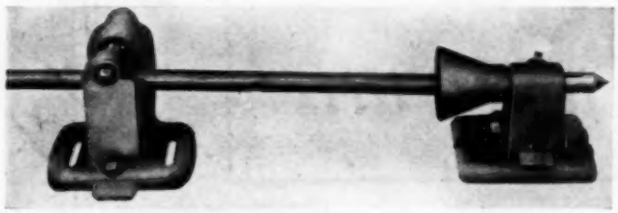


Fig. 10—The footstock of this work holding fixture has a combination center

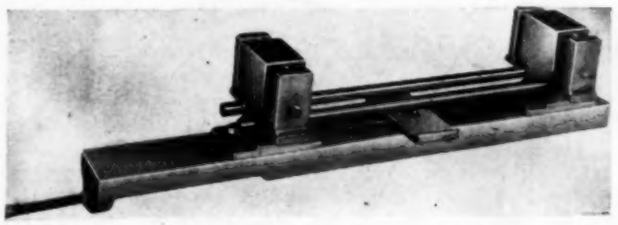


Fig. 11—The work holding fixture may be slid and clamped in different positions on the machine table

end to a length equal to the nominal capacity of the machine. The cutters are then withdrawn and the auxiliary table is loosened and slid along the table of the machine until the other end of the slot is within the stroke of the machine. Allowing an overlap of one inch, the spline miller with a six-inch stroke can cut, in two settings, a slot eleven inches long plus the diameter of the cutter.

The part that the spline miller plays in production is not very widely known because the parts produced are used largely in the more complicated mechanisms. In some cases spline milling is done because it is cheaper; in others, because it is more accurate, and sometimes because it can be done no other way. The field of the machine is rapidly enlarging.

CHROMIUM is distinguished from other metals by two characteristics, its hardness and its smoothness. The co-efficient of friction of the metal is extremely low, so low, in fact, that it may be used as a coating material on the bearing face in a "greaseless bearing," if the sliding surfaces carry a fairly heavy coating of the metal. The chromium plate, however, is very brittle, and cannot withstand repeated shocks or blows. It is useful as a coating against rust and, in thick layers, to provide greater wear resistance and durability to moving parts of machines and like equipment. Examples of this use are found in automobile parts, such as wristpins, steering knuckles, and brake parts, as well as in stamping dies, extrusion dies, roller faces, and plug gages.

Mycalex—A Machinable Insulation

By W. W. Brown

Radio Engineering Department, General Electric Company

MYCALEX is a molded insulation, formed from ground mica and lead borate. The mixture is heated to the softening point of lead borate (approximately 675 deg. C.) and compressed while plastic. Moldings are cooled under compression and removed when the lead borate binder has solidified and cemented the mass firmly. The material is molded under pressure of approximately 10,000 lb. per sq.in. This high pressure, combined with the high molding temperature (approximately 500 deg. C.) requires relatively complicated and expensive molds.

Shapes available include slabs and octagonal rods. Special sizes and shapes are obtained either by machining standard moldings or by special molds. The material may be sawed, turned, drilled, ground, or polished. Although the material may be machined by methods similar to those used in machining marble, using ordinary tool steel, these operations are greatly simplified and speeded up by the use of the newer alloy tools. Special and intricate moldings are produced in molds when the quantity required justifies the cost.

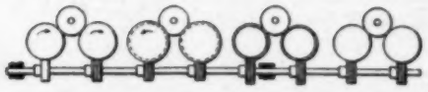
In addition to being easily machinable, the material has a low dielectric loss, high dielectric strength, high tensile strength, and high resiliency. These properties in combination are found in Mycalex in a higher degree than in any other material. The compressive strength of Mycalex is 25,000 lb. per sq.in., as compared with 55,000 for porcelain and 200,000 for fused quartz. Its tensile strength is 6,000 lb. per sq.in., as compared with 6,000 and 8,000 for porcelain and quartz, respectively. Its transverse strength is 16,000, as compared with 11,000 for porcelain, and its resistance to impact is 0.48, as compared with 0.23 for porcelain.

The surface of the material is highly resistant to arcing. Continued arcing along the surface produces a path of fused lead borate, similar in appearance to glass. This path is only on the surface and, when scraped off, leaves the surface without permanent injury. The material does not crack or burn beneath the surface as most other available insulating materials do. Although practically non-hygroscopic, the surface as molded is not as smooth as the glaze on porcelain. For outdoor applications, therefore, the moldings are ground or otherwise polished, producing a surface comparable with glaze. The surface, as molded, is entirely satisfactory for indoor use.

Although the cost per pound is considerably higher than that of porcelain, the small quantity used for a given insulator brings the unit costs to a comparable basis. This condition is further brought about by the fact that fittings may be molded in or around the material, thereby avoiding the additional expense of cementing or otherwise attaching the fittings to porcelain and similar insulating materials. Interruptions of service as a result of the failure of Mycalex have been practically negligible in its use up to the present time.

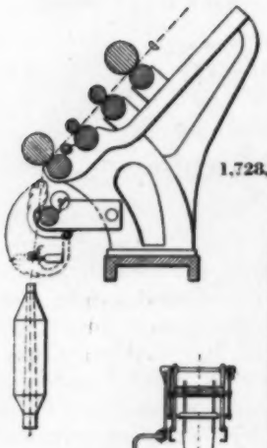
An abstract of a paper presented at the meeting of the communication group of the New York Section, A.I.E.E., on November 13.

Textile
Machines and Parts



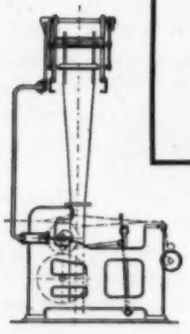
1,728,878—Wet treater for hanks

1,728,417—Cop or cone holder

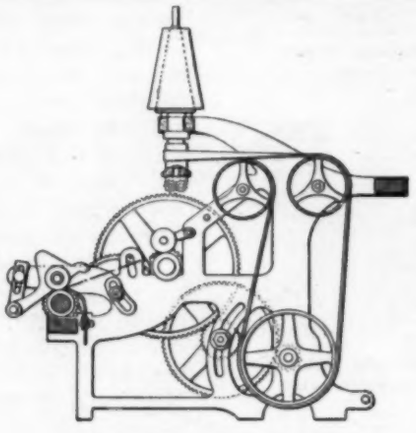


1,728,707—Spinning machine double-preventer

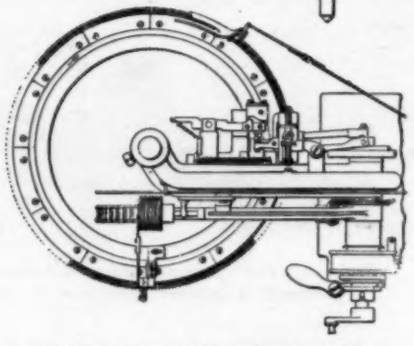
1,728,708—Spinning-frame lubricating device



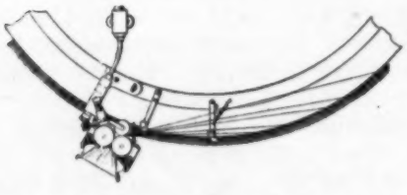
1,728,824—Bobby and Jacquard loom drive



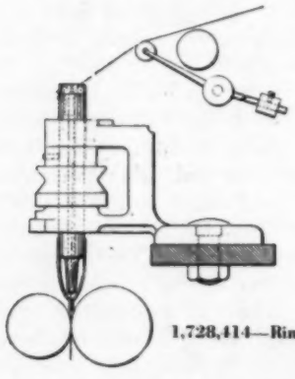
1,728,663—Twisting machine



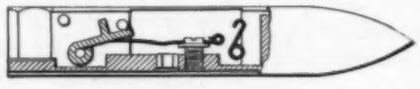
1,728,714—Looped fabric sewing machine



1,728,715—Raveler for looping machines



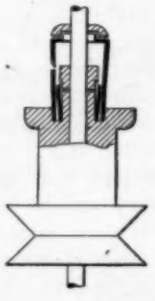
1,728,414—Ring-spinning frame



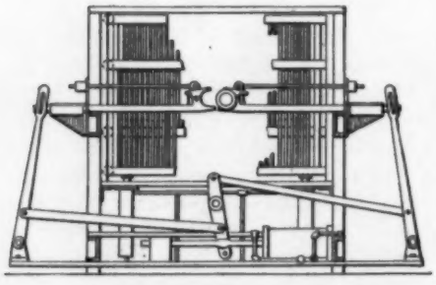
1,729,524—Shuttle

1,729,413—Shuttle

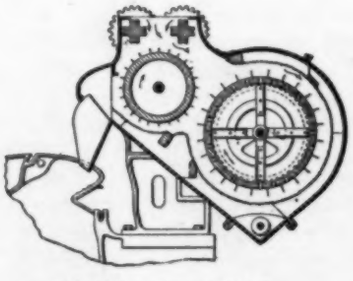
1,728,256
Jacquard-card holder



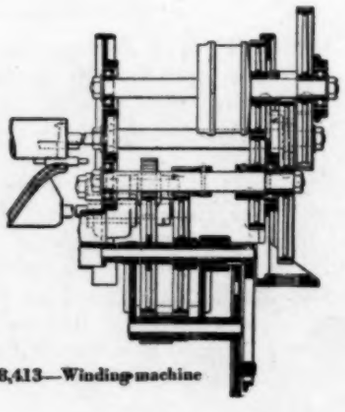
1,726,764—Bobbin holder



1,728,497—Weaving machine

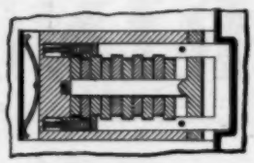


1,728,501—Cotton Cleaner

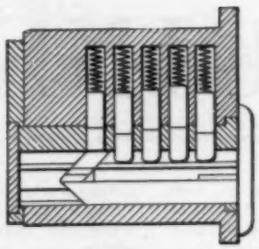


1,728,413—Winding machine

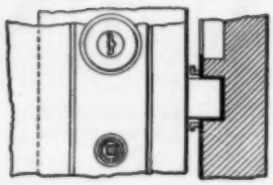
Hardware
Designs



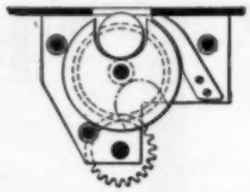
1,728,903—Combination door lock



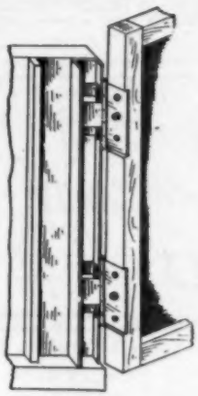
1,728,310—Cylinder lock keyhole plug



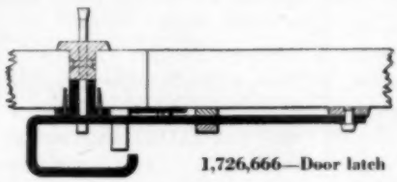
1,727,323—Door lock attachment



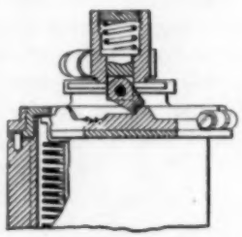
1,725,497—Coin-controlled lock



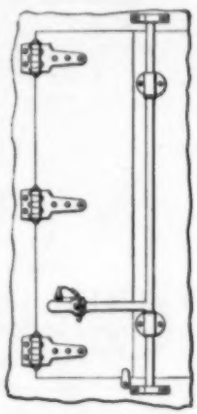
1,728,539—Sliding screen hinge



1,726,666—Door latch

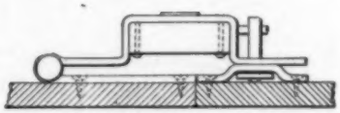


1,728,693—Door closer check

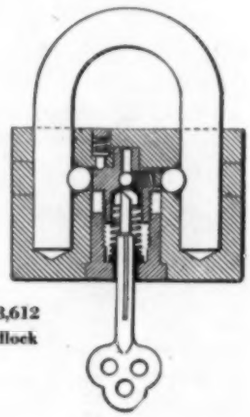


1,728,530
Door-securing mechanism

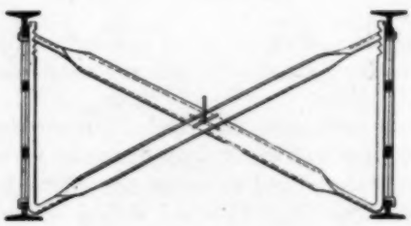
1,727,574—Staple strip



1,726,162—Hasp and lock

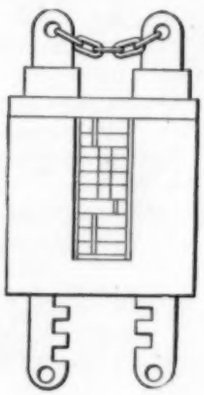


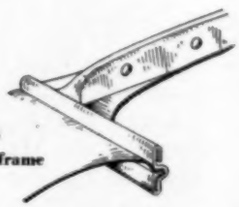
1,728,612
Padlock



1,725,414
Structural bracing member

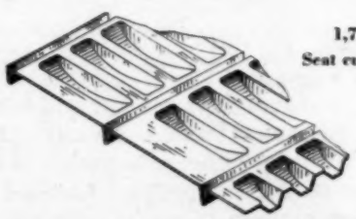
1,728,902
Combination padlock





1,728,235
Seat cushion frame

1,726,316
Clothes hanger

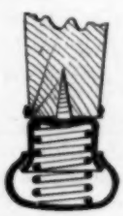


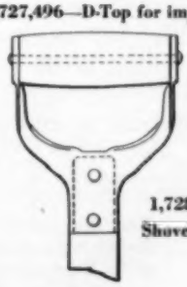
1,724,892
Spring support for furniture

1,727,976—Caster

1,727,496—D-Top for implements

1,726,696—Sheet metal lath





1,728,320
Shovel handle

1,727,188—Window frame and sash

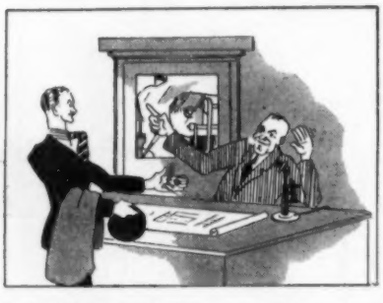
United States patent number precedes each caption

THE ENGINEERING

The scene is a big contract production shop, consolidated also with an iron foundry and a nonferrous metal plant. It controls, also, a smaller shop that makes a specialty of contract production for the chain stores and mail-order houses. Conferences of the engineering and affected production executives with the chief engineer have grown into what the plant calls "The Engineering Council," which meets in a "council room" in the engineering department. Foremen are called in, and others drop

Do You Still "Roll Your Own?"

"GENTLEMEN," began Manager Hedley, as the engineering staff gathered around the conference table, "I want you to consider one thing this morning, and that is the matter of calling for commercial parts where possible in your designs. The purchasing agent tells me that he can equal, if not beat, the shop cost price every time, and I don't see the reason for taking up machine time on things that you can buy in every supply house in the country."



"Just what do you refer to, Mr. Hedley?" said Chief Engineer Art Levering. "I think you'll find we have a good reason for every job we throw into the shop."

"Well, springs, bolts, screws, for example. Then, only yesterday I saw Department 16 turning up a lot of bearing bushings out of regular drawn stock."

"We do use commercial screws where we can, Mr. Hedley; but you can't expect to call for standard commercial articles where you want close fitting or high strength, can you?"

"Maybe not—but I have an idea that we can—that's what I want you to decide before we close inventory at the end of the year. Just tell me, Art, what steel did you use in those cap screws for the front plates in the last machines?"

"That was special nickel stock, heat-treated. Had to be, as those screws take the pulling strain."

"Fine as an example," interrupted Hedley, "the shop tells me that bunch of screws caused them a lot of trouble and Paul is ready to testify here that he can get heat-treated nickel-chromium cap screws that Brinell at 320 and beat yours all around for strength. And he can get them on two weeks' delivery, for less than ours cost us.

"It's just this that I want to impress on you designers this morning. The shop is apparently willing to make anything you call for, and I appreciate the pride everyone takes in being able to say that we make our product completely—from soup to nuts. But we're machine-builders in a larger way, and we're not specialists in the smaller, but no less important, elements. We're not big enough to afford a dozen research specialists and make laboratory tests on the elements—we've got to spend our design research on improving our ultimate product. Let's buy specialized products from specialists!"

"I don't see where you're going to draw the line on what is a specialty," doggedly put in Lines, the chief draftsman.

"That's for you to determine, Andy. Seems to me it depends on how grown up you are, and how you want to divide your time between the ultimate design job and the details. When I was a boy in the country, the family used to make its own soap and yeast cake. Now they spend the time earning money, and buy better soap and bread out of the small change."

"Well, Mr. Hedley, I'll tell you what I'll do," spoke up the chief engineer, "we'll get together with the shop and the stores department, and have them kill all running shop orders for special parts that we possibly can before the new year. The rest seems to be up to the designers. Guess I'll appoint a committee of them to start right away, and build up a better engineering department library of parts catalogs. We'll let you know."

You can call on your shop force to make everything, and they may be proud of the achievement, but is it always good design to do so? Real design should go into the small units, but whose job is it to put it in? Publishable answers from designers will be paid for.

COUNCIL

in. The problems are not solved for the readers, but some of the opposing opinions are brought out. Engineers and designers are invited to discuss the problem, or to present new problems for discussion. Acceptable letters are paid for at regular rates.

DISCUSSION OF COUNCIL TOPICS

Who Should Design Patterns?

THE answer depends on the size of the factory. In a small plant, where the pattern shop and foundry are managed by one foreman, the patternmakers should design patterns to the foreman's instructions; and it follows that the foreman should be capable of giving these instructions. All designs of castings should be submitted to him for criticism before being decided on definitely. In larger plant the foundry superintendent will require at least one assistant whose main duty is to maintain contact between design, patternmaking, and molding departments, and who is free at any time for consultation by draftsmen during the working out of a design. In one plant employing a large staff of designers, but having no foundry of its own, the most satisfactory arrangement provides for all complicated castings to be designed by two draftsmen who keep in close contact with the head patternmaker.

When small numbers of large or complicated castings are required it is better to err on the side of excess weight than to risk making much scrap. But if any considerable quantity of parts is required, experimental work always should precede production and the cheapest design should be adopted. Taking into account such diverse factors as machinability and balance of moving parts, a light casting in an expensive iron with a large proportion of scrap in the foundry may be cheaper than a heavier one in a cheaper iron with a minimum of scrap or vice versa. The foundry superintendent, or his assistant, should oversee this experimental work. —H. JAMES.

WHEN the works does not have its own foundry, the only way in which satisfaction may be obtained is to leave the designing of patterns to the patternmaker. Of course, it is quite necessary to submit to him blueprints of intricate castings before the design is finished and to keep in contact with him later. This way of handling has the advantage of leaving each man responsible for his share of the work, and it avoids the necessity of having a special draftsman to design patterns which, usually, do not fit the wants of the foundry after they have been designed.—M. N. LEDERC, *Chief Designer, Appareillage Gardy, Geneva, Switzerland.*

A GREAT deal of trouble, delay, and spoiled work can be eliminated if there is a proper liaison between the designer and the pattern, foundry, and machine shops. There is considerably more to proper pattern making than constructing a model of the part to be cast. The patternmaker should have a working knowledge of foundry and machine shop practices. Poor patterns and molding often result in shrinkage spots, cracks, chills and washes which give the machine shop trouble and consume profits.

The managements of pattern, foundry, and machine shops should work with the designer, and, also together, in the putting forth of a new part, unless the plant is so large that special talent can be employed profitably to oversee this phase of the work.

—DOUGLAS L. PARKHURST, *Chief, Instrument Division, U. S. Coast and Geodetic Survey.*

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Developing New Products

MY OBSERVATIONS lead me to believe that, in a majority of medium-sized and smaller plants, it is not economical to break into the regular work to get out experimental jobs. Usually, such work is either neglected or "botched" as a result of the demands of the regular organization to get out production requirements.

Work of this sort is best handled in a separate experimental department, using all-around mechanics to do the work. This department should be supervised by either a company engineer or a professional development engineer, engaged for the time necessary to complete the project. In either case, the engineer should report directly to the general manager, although a committee composed of the sales manager, service manager, chief engineer, and production manager should assist the general manager, each from his own angle.

There are many advantages in hiring an outside man, the chief ones being his absolute freedom to function without hindrance, and his liberty to express his opinions without fear or favor. Another advantage of this plan is the opportunity of having new ideas injected into the development through such a man's contacts with operations in other plants. Of course, the man selected must be diplomatic in addition to being a good engineer and executive. His first step should be to get the individual ideas of department heads and to check up on competition in order to get an idea of the method of production and the approximate price at which the product may be sold. The result of a plan of this sort is as near an ideal machine as it is possible for the organization to manufacture, sell, and service.

—WILLIAM E. HAMILTON, *Industrial Engineer.*

DEVELOPING new products under any circumstances is a difficult problem. When the firm cannot afford an experimental department, the situation is even more complicated. Hiring a development engineer and expecting him to design a new product, then follow it through the various departments and be responsible for the finished product, would be asking a good deal of him. Such a plan would cause no little dissension in the plant.

All department heads have their own ideas, and many of them would think they knew, better than the engineer, what should be done. The better plan would be to have him make his drawings and have them go through

regular channels to the department heads who would be held responsible for accuracy.

Some firms have done very good experimental work by placing the development engineer in charge of the repair department and having this department do experimental work. The engineer does his own designing and has the men in the repair department do the work. Of course, he hires his own men and is the sole supervisor of all work done in his department. In this way, he is in a position to supervise his work without interference.

—W. J. Owens, *Newport Rolling Mill Company.*

IT IS not necessary to form a development department or even hire a development engineer to follow through the development of a new product. This phase of the work can be handled as routine work by the sales department, engineering department, and shop. The major necessities are a continual checking back and a series of conferences between the three departments as the product is developed.

The sales department should give the engineering department a definite idea of what is required, including estimated cost, materials, wear required, and other facts which the sales department is in the best position to ascertain. The engineering department takes this information and works as closely as possible to the requirements for selling the finished product, reporting any necessary deviations to the sales department and working them out immediately. Details of machining, production, best materials, cost of making, and similar production information can be ascertained from the shop foremen as the design progresses, and these facts, in turn can be referred to the sales department. The job then goes to the shop, where further suggestions to improve the product may be made by the shop foreman. Usually, such problems can be settled by the shop foreman and the chief engineer without consultation with the sales department. In this way, the job goes from one department to another, each finishing its assignment as completely and efficiently as possible with the data available.

It may seem that there is a lot of lost motion in this plan, but the advantages derived from the scheme more than offset its disadvantages, in savings of materials and other expenses. In addition, it keeps men in the regular sections of the shop interested in the development of new ideas, and the result is increased enthusiasm and a definite effort to work together to bring a new design to a successful conclusion.

—Victor H. Van Horn, *Design Engineer, Doehler Die Casting Company.*

THE idea of having one man follow through completely the development of a new product is not merely an embryonic, idealistic thought, but a procedure that has stood the test of time in many industries. In the aircraft field, where the idea has perhaps attained its greatest practical development, such a man is known as a project engineer. While his direct authority is limited to design, he is responsible for the co-ordination of the job as a whole. As a designer, he is responsible to the chief engineer, but for the job as a whole, he is responsible directly to the general manager.

The project engineer is particularly useful and almost a necessity where a separate development or experimental department is not available and development work must be done in production shops. Under such conditions, it is necessary for the shops to have readily available one man to whom they can bring disagreements, difficulties, or suggestions. Otherwise, there would be a tendency for a busy shop to make a finished piece as nearly as possible like the drawing, and get it out of the way, whether it was a good job or not.

Such a man need not always be a specialist in each new product, but should be a specialist in developing new ideas, provided they at least bear some relationship to each other. A good all-around man will ultimately develop into a better project engineer and be worth more to the organization through his intimate knowledge of the organization, than would a different out-and-out specialist, hired for each job, and consequently completely unfamiliar with the organization. The project engineer is usually best developed by taking some one long associated with the concern and thoroughly familiar with all functional details. In this way, there will be a certain continuity of design, fabrication, and materials, even though the products are not definitely related.

—Charles E. Kirkbride, *Project Engineer, Naval Aircraft Factory, Philadelphia.*

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When Sales Take a Slump

A LOGICAL way to have designers keep in active contact with customers' requirements is to have some sort of report from the field men. This should not take the form of a too formal report which might well prove a nuisance, but should be merely an informal expression of opinion or facts at the time of occurrence. Thus, the salesman who loses a sale to a competitor would forward an expression of opinion as to why the sale was lost. Similarly, a repair man would report as to the facts of the breakdown or difficulty he encountered. Properly summarized, these reports would disclose any decided trend towards a weakness in design or a failure to meet the consumer market. Many times, one relatively small weak link, easily redesigned, may be at the bottom of most of the operation difficulties, or one competitor's asset, easily duplicated or improved upon, the cause for a large loss of competitive sales.

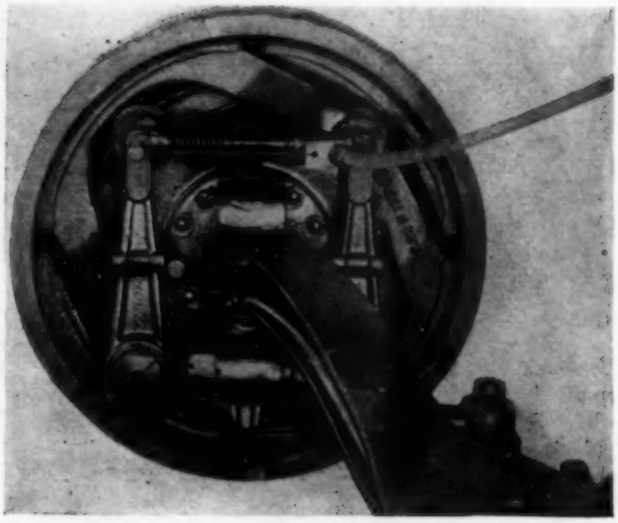
One effective way of solving the problem, particularly when the product is sold directly to the consumer and is operated by laymen, is to run a continuous test of one's own product in competition with that of one's competitors. Generally, such tests are best not run by laboratory personnel, but are most effective if some person of mediocre responsibility—in the case in question, a janitor would suffice—were employed to run the test. Neglect is just as important a criterion of operation for real results as any other than can be simulated in the laboratory. Intermittent operation, under-lubrication, and similar mistreatment, should be test factors. The analysis of the results, however, should be made by the designers themselves.

Sales literature of competing products makes good reading for designers. Analysis of competitors' materials is good work for the metallurgist. Customer correspondence is often advisedly routed through the engineering department for comment. A day with the service man or salesman is a good investment of the designer's time. Summarized briefly, contact is an important adjunct to any designer.

—L. J. Yapp, *Design Draftsman, Naval Aircraft Factory*

BRAKES and Brake Materials

Prominent bus and truck engineers express preference for hydraulic systems with power-operating means. Non-metallic lining and cast drums favored



Front wheel brake installation showing external hydraulic cylinder and shoes with pressue uniform at all points on drum circumference

BRAKE design, especially in types applicable to automobiles, buses, and trucks, has undergone rapid and far-reaching changes in the past six years. The problems involved are complex, and the importance of safety is so great that automotive engineers have, of necessity, made an intensive study of the subject. Growing demands for high speed and insistence upon greater comfort and safety for drivers as well as passengers have added to the difficulties to be overcome.

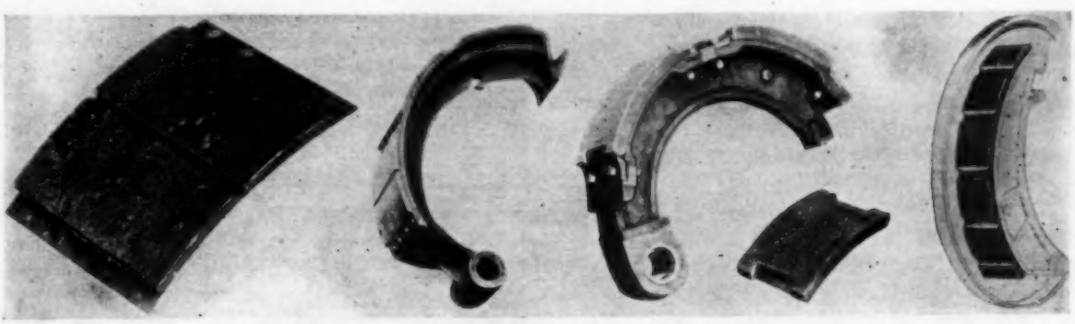
Not all of the problems have been solved, but an outline of the advances made to date, and an idea of what remains to be done are given in two well-grounded papers recently prepared by engineers of high standing. The first of these, by George A. Green, vice-president in charge of engineering, General Motors Truck Corporation, deals with bus (motorcoach) brake applications. The second, by G. B. Ingersoll, Chief Engineer, Federal Motor Truck Company, treats of brakes for motor trucks. Both papers were delivered before the Transportation Meeting of the Society of Automotive Engineers last month, the former having been prepared originally for the World Engineering Congress in Tokio, Japan, held at about the same time.

Several points stand out in these papers. Demands for higher speed have led to the general adoption of balloon tires. Insistence upon lower floor heights have limited the maximum tire diameter. Both in turn have reduced the inside diameter of the tire and limited the size of brake drums to about 17 in. maximum, while heat-radiating capacity has been reduced, especially where duel tires are essential. In consequence, the number of braking surfaces have had to be increased. Brakes on four or more wheels have become a practical necessity on most heavy vehicles.

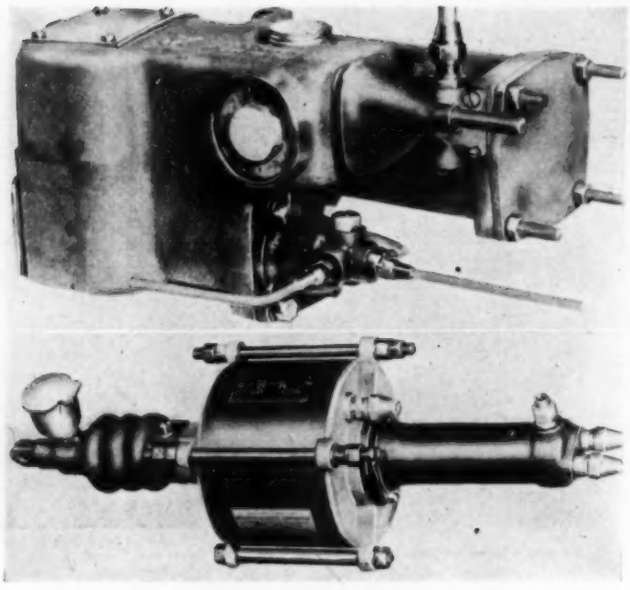
Again, pressure between brake drum and brake shoe has been increased of necessity to a point where drivers cannot exert enough force to give the required pressure. Power-operating mechanisms are the natural alternative. Direct-acting mechanisms have limitations which have made air and hydraulic operation desirable in many cases. Higher stresses, increased weight, and complexity of mechanism introduce further complications both in design and servicing. So the problem has grown. To meet it, new materials, as well as new mechanical arrangements, have been developed.

Space limitations preclude giving the full text of the two papers referred to, but some of the more important points will be summarized. In regard to bus brake design, Col. Green makes the following among other points:

In passenger cars of the more prominent makes there are from 15.6 to 17.5 lb. of gross weight of the fully loaded car per sq.in. of service-braking surface, but in bus applications the gross weight runs as high as 195 lb. for each sq.in. of area. Yet bus brake drums cannot be much more than 1 in. in diameter larger than the largest passenger car brakes. This is one reason why the braking problems in bus design are much more difficult than in passenger car design, and have led to many changes.



Three forms of molded brake lining, adapted for attachment with rivets, in some cases, and with bolts and clips, in others



Two makes of combined vacuum booster and hydraulic master cylinder nuts. At the top is the Westinghouse design and below the Bragg-Kliesrath design

An advantage of mechanical braking systems is the ease with which connections are traced, but the disadvantages include:

1. Difficult geometrical problems resulting from complex motion of axles and wheels, especially where four or more wheel brakes are involved.
2. Much skill is needed to effect the best adjustment.
3. Numerous rods, shafts, bearings, clevices, and other parts require frequent attention.
4. Undue wear, noise and friction result unless lubrication is frequent.
5. The large number of parts increases the possibilities of failure.
6. The large diameter cross-shafts and other parts required increase weight and cost.
7. Power application is necessary to insure reasonable pedal pressure.

Air-operated brakes present the following advantages:

1. No geometrical problems are encountered.
2. Minimum physical effort is required, and this effort is in proportion to the pedal pressure.
3. Equalization is automatic and exact.
4. Air-pressure for operating doors and other devices is available.
5. Railroad organizations, the largest potential users of buses, are accustomed to air brakes and understand the problems such brakes involve.

The disadvantages of air-operated brakes, which appear to be outweighed overwhelmingly by the advantages include:

1. Tracing troubles and making correct adjustments requires experience.
2. Failure of any connection makes the system inoperative.
3. The cost greatly exceeds that of a mechanical system.
4. The mechanism is complicated.

Despite their complication, air brakes are reliable and relatively free from trouble, while service facilities are widespread.

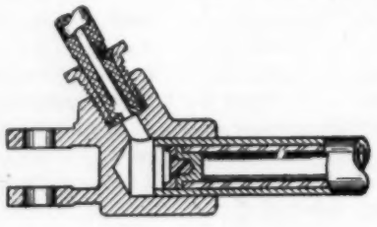
Hydraulic brakes, used thus far only on light- and medium-duty buses, have proved very satisfactory. Rods and their connections are replaced by incompressible liquid columns. No cross-shafts are required, and the mechanical efficiency is constant. Other advantages include:

1. No geometrical problems are involved.
2. Lag and lost motion are minimized—a decided advantage over both air and mechanical brakes.
3. Equalization is automatic.
4. Both cost and weight are less than in either air or mechanical systems.

The disadvantages of the hydraulic brake system include:

1. A special fluid is required, although this fluid is inexpensive and easily obtained.
2. Adjustments require less skill than with air-operated brakes.
3. For moderate pedal pressures the use of power-application is required, as with mechanical brakes.
4. Railway operators are not acquainted with hydraulic mechanisms.
5. Failure of connections causes loss of fluid and makes system inoperative.

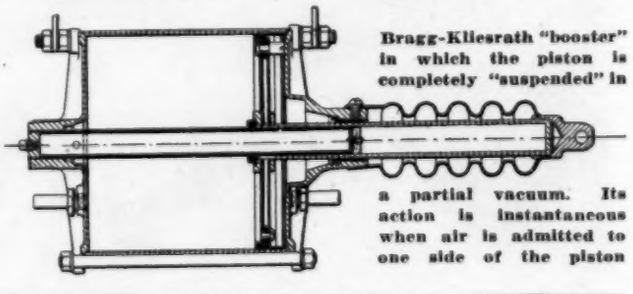
A factor which seems to make possible the successful application of hydraulic brakes to heavy-duty buses is the recent development of brake-operating cylinders mountable outside of the brake itself, where it is easily accessible. Compact units combining master hydraulic cylinders with "boosters" operated by the partial vacuum in the engine intake systems now are made by the Bragg-Kliesrath Corporation and by the Westinghouse Air Brake Company.



Sectional views of an external cylinder for hydraulic brake operation. The external location helps to keep the liquid used from being volatilized by the heat generated in friction

Hydraulic brakes seem to have an advantage in simplicity over both air and mechanical types. Their installation involves no serious problem, and the general appearance is neat. The advantages far outweigh the disadvantages, and this type of brake design seems likely to be extended to heavy-duty coaches.

Metal-to-metal brakes, so successful in railway use, unfortunately have proved impracticable for buses



Bragg-Kliesrath "booster" in which the piston is completely "suspended" in a partial vacuum. Its action is instantaneous when air is admitted to one side of the piston

because of the different conditions as to bearing surfaces, dimensional limitations, heat transfer, and heat storage. The external shoe brake is not applicable in satisfactory form. Metal shoes possess excellent heat-absorbing properties but have these disadvantages:

1. The friction coefficient varies with the speed.
2. The wheels tend to lock as the vehicle comes to rest, and the difficulty of assuring a smooth stop increases the accident hazard, while harsh operation has a bad effect on the equipment, hence greater care is required in operation than with molded or woven linings.
3. Cutting and scoring of both shoe and drum are the rule; the life of both is short and is shortened further by careless operation.
4. The renewal cost of both shoes and drums is excessive.

Until quite recently metal-to-metal, air-operated brakes were given preference, but this attitude seems to be changing, chiefly as a result of the availability of improved brake-drum and brake-lining materials, especially close-grained, cost-iron drums and molded block linings.

Low first cost and long precedent seem to be the only reasons for the present use of woven brake linings for they have the following disadvantages:

1. No two makes are alike, and all makers have different views as to what constitutes a good lining.
2. It is difficult or impossible to obtain woven linings thick enough to have reasonable life. Moreover, thick woven linings are compressible, and this interferes with satisfactory operation.
3. Impregnating substances are inflammable, and give off unpleasant odors when hot.
4. The common use of wire binders causes the scoring of drums and thus decreases their life.

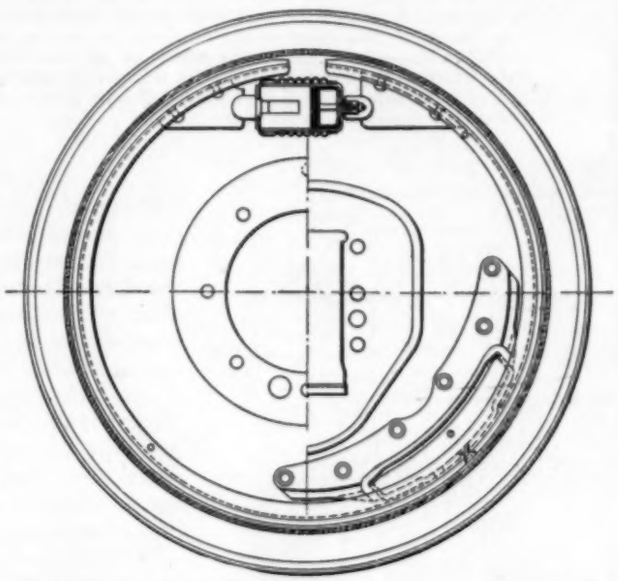
Molded linings, on the other hand, can be had in thicknesses greater than the woven type, and are not compressible to the same degree. The greater thickness permits of better fastening means, including integral keys, and minimizes the chance of scoring. Wire binders are not required, and this also minimizes the possibility of drum scoring. Although the coefficient of friction is less for molded than for woven lining, added pressure can compensate for this. The higher cost of the molded lining also is offset by lower maintenance costs. Thus, the molded lining seems to overcome nearly all the disadvantages of the woven type, and the thick bolted-on type presumably soon will be in general use.

The use of propeller shaft and air- or hydraulically-operated wheel brakes has the following advantages:

1. Elimination of cross shafts with attendant reduction in weight, cost, number of parts, need for service, and chance of failure.
2. Fewer adjusting points reduce wear and possibility of mal-adjustment.
3. Simplification of adjustment and automatic equalization.
4. Geometrical problems are eliminated.
5. Compliance with legal requirements is unquestioned.

Propeller-shaft brakes must be balanced carefully to avoid vibration. The heat dissipation problem is difficult, but can be solved. Additional stresses are imposed upon axle and propeller shaft parts by a propeller shaft brake. These must be allowed for and such a brake should be used only where reliable four-wheel brake equipment is employed.

While the foregoing comments of Col. Green were written as applying to buses, it is evident that many of them apply also to brakes for trucks, and in some cases also to brakes for other purposes. Operating conditions for the average truck, especially in respect to servicing, are likely to be quite different from those applying to buses, and for this reason it does not follow that a design which is excellent for buses is sure to be satisfactory for trucks also, as some of the following comments, summarized from Mr. Ingersoll's paper relating to truck brakes, indicate.



A 16-in. hydraulically operated brake which employs a single shoe of channel section covering nearly the full circumference. The lining is said to wear uniformly throughout its length and to be good for fully 50,000 miles of service on a truck of 10,000-lb. gross load

As a result of his experience with many types of brake systems the author predicts that four-wheel truck brake systems of the future are likely to comprise five brakes: one in each wheel for service use, and one on the propeller shaft for emergency purposes and parking. These brakes, he predicts, will be of the internal type, fully enclosed, but will have means for increasing the air flow between drum and wheel to facilitate better cooling. Operation will be by fluid means, that is, hydraulic or air, partly to attain complete equalization and one-point control for simultaneous adjustment at all wheels. The design will be such as to give equal pressures and lining contact over practically the full circumference of the drum.

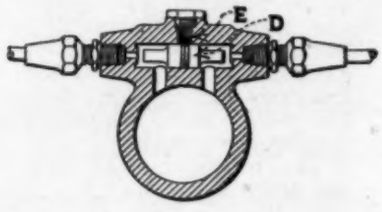
There will be a safety device so arranged that breakage of an oil lead to one set of brakes still will leave another set operative. Vehicles up to 12,000 pounds gross load will have brakes with servo (self-energizing) features so that ordinary pedal pressures will suffice for satisfactory operation. On vehicles of greater load capacity power-actuated means of applying the brakes will supplement foot pressure. Drums of non-scoring cast metal, good for 200,000 miles of service, will be employed. Wheels will be of sufficient size to give an adequate air gap between wheel rim and brake drum. An easily detachable lining, or lining-and-shoe assembly, will be provided.

The hand-brake will be internal, fully enclosed, and have equal pressure on almost 360 deg. of its circumference. It will have a capacity sufficient to slide the wheels in an emergency, but will be easy to operate for ordinary use. Adjustment will be made at a point outside of the brake itself. The drum will be of minimum

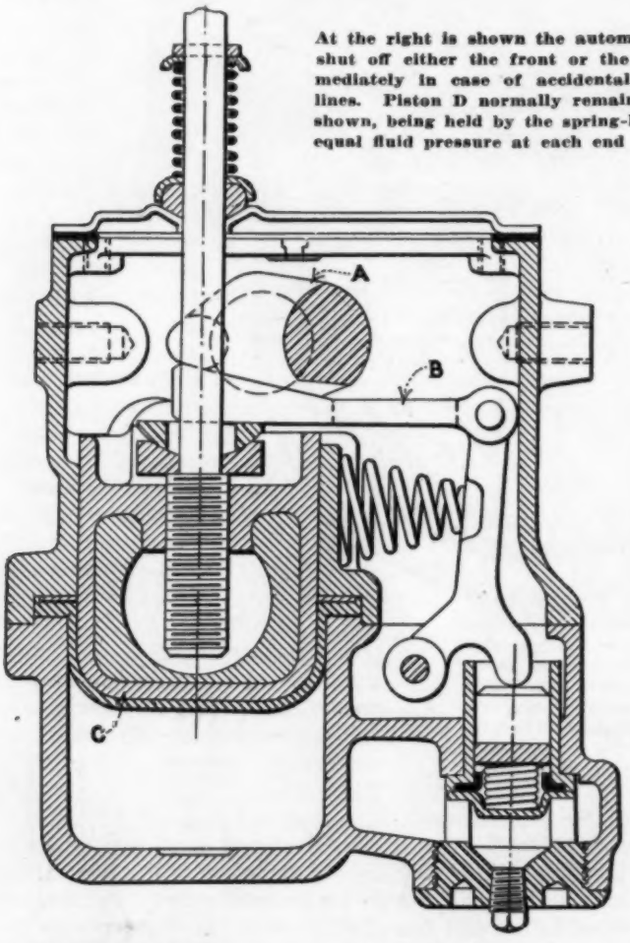
diameter, light in section, and of non-scoring material good for the life of the vehicle.

These are merely the conclusions reached by the author. He describes a larger number of systems and parts that he has tested, which, taken as a whole, seem to embody all the features considered desirable, indicating that they are readily attainable singly, if not already combined in any one system. A few of these parts are pictured in accompanying illustrations. Some of Mr. Ingersoll's observations concerning brake materials are condensed in the following paragraphs:

Ordinary brake linings, formerly successful, quickly squeeze out under the high pressures employed today. A dense homogeneous lining that maintains proper braking action and wears slowly, even when hot or cold, wet or dry, is demanded. Some of the highest grade stitched and folded linings, impregnated and vulcanized under high pressure and temperature, give reasonable service in trucks up to 10,000 lb. gross load when ground drums and other conditions are satisfactory. But for brakes applied by power means, molded linings have been used with considerable success. This material has high heat resistance, produces no objectionable odor when hot, maintains a uniform friction coefficient, is not susceptible to troubles when wet, and is impervious to oil. It is available in thick blocks designed to be held by bolts, or keepers, and thus is replaced easily. Transverse grooves in this lining keep the surfaces free from grit and moisture and tend to polish the drum surface, preventing scoring and drum wear. Operation is smooth and noiseless.



At the right is shown the automatic safety valve used to shut off either the front or the rear pair of brakes immediately in case of accidental breakage of connecting lines. Piston D normally remains in the neutral position shown, being held by the spring-loaded plunger E and the equal fluid pressure at each end



Combined fluid reservoir and master cylinder. The shaft projecting through the top of the cover can be brought up through the floor boards. Turning this shaft is all that is required to adjust all four wheel brakes simultaneously. The cam A, mounted on a shaft connected to the brake pedal, contacts with the wedge-shaped lever B which actuates the master piston C. The second piston and lever system shown makes automatic compensation for the expansion and contraction of operating fluid with changes in fluid temperature

Ordinary pressed steel drums under heavy pressure show undue wear, regardless of the friction material used, because the high temperatures cause flaking, and the flakes become imbedded in the lining and score the drum. Cast drums of high-chromium nickel alloy afford a crystalline structure. Contact is against the ends of crystals rather than against a metal "grain," as in steel drums, and there is no flaking even under extreme heat. Such a drum has a dense structure, unaffected by temperature changes. With proper lining the operation is practically noiseless. The material used today has a tensile strength of 45,000 to 60,000 lb. per sq.in., high impact resistance, and a 260 to 275 Brinell hardness.

With the present heavy pressures, even drums of exceptional thickness distort noticeably. The maximum possible wall and flange thickness and ribbing must be used, and this, doubtless, will make it necessary to increase wheel base-diameters from 20 in. to 22 in. Air apertures in the flange should be provided to aid heat dissipation, even at the sacrifice resulting from ingress of dirt. The expedient of drilling a few holes in the drum, in one case in which the heat generated was sufficient almost to vulcanize the tires, has been known to double the life of brake linings. With the type of drum above described, 100,000 miles of service with only $\frac{1}{16}$-in. change in diameter resulting from wear is not impossible.

In the installations described the hydraulic brake fluid used was composed of diacetone alcohol 60 parts, and castor oil 40 parts. This mixture proved entirely satisfactory under all average conditions. It has a higher boiling point than the mixture composed of equal parts of castor oil and denatured alcohol formerly employed. At sub-zero temperatures the proportion of diacetone alcohol may be increased to make the brakes freer in operation.

Push rods, steel bushings on steering bridges, and copper pipe connections on the fuel and oil lines of airplanes usually have silver-solder joints to withstand the tremendous vibration set up. Silver solders fuse at from 1,600 deg. F. down to 1,325 deg. F., according to the silver content, thus making them available for use on metals with melting points above that temperature range. In addition to their strength, toughness, and resistance to relatively high operating temperatures, they have a higher electrical conductivity than copper, and are, therefore, used in securing resistance wire to terminals, leads in radio resistors, and in similar places.

ABSTRACTS OF A.S.M.E. PAPERS

The following are abstracts of some of the papers presented at the Fiftieth Annual Meeting of the American Society of Mechanical Engineers, Engineering Societies Building, New York, December 2 to 6

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Design of Rail Motor Cars

By CHARLES O. GUERNSEY

Chief Engineer, Automotive Car Division, The J. G. Brill Company

WHILE the rail motor car is not new, having been commercially introduced during the early part of the present century, it was not accepted as an important unit in the economics of rail transportation until very recently.

Rail motor cars are at the present time in service in sizes ranging from single cars developing about 70 hp. and weighing about 15 tons, to 800-hp. cars capable of handling a number of trailing cars. Even larger sizes are being discussed at the present time. Cars now in successful service cover a field broader than any advocate would have dared predict as recently as five years ago. The sizes using power plants of 200 hp. and less are generally arranged with mechanical transmission. Usually they are limited to use as single car, or at most, with one comparatively light trailing car, and are produced principally for export. Cars ranging from 250 hp. upward are practically all of the gas-electric type. A great majority of the cars being produced for the American market are of this type.

The success of the rail motor car in performing any service depends upon satisfactory design, satisfactory application, proper operation, and proper maintenance. The design is, and properly should be, the function of the manufacturer. By reason of the engineering sales and servicing staff which he maintains, he is constantly in touch with rail-motor equipment throughout the world, and is in a position to profit from experience gained in all sorts of applications. Furthermore, since the manufacturer is selling his product to many different railroads to meet many different conditions, he is compelled to spend sums in development far beyond what any given railroad might reasonably spend for the same development. Also, by reason of the time and care which the manufacturer can and does necessarily take in the development of new apparatus, he is able to turn out a properly co-ordinated, well-balanced unit, which would hardly be possible for any railroad to do without undue expense, test, and experimentation.

The designer should bear in mind the following requirements: (1) As near absolute reliability as possible, (2) maximum availability for service, (3) long life, (4) performance, (5) ease of adjustment and repair, (6) simplicity, (7) low maintenance cost, (8) low first cost, and (9) light weight.

Various kinds of power equipment have been built for rail-car work, including steam plants of various types, and a number of Diesel equipments. The experience with steam plants has been limited to one or two cars. It seems that for conditions within the United States, the Diesel cannot as yet be classed as a competitor with the carburetor-type engine for rail-car work. For the present, at least, it has not been accepted for our conditions. In this paper, therefore, only the carburetor-type internal-combustion engine will be considered.

When considering the relation of engine horsepower to train weight, the efficiency and factor of utilization of the transmission equipment must, of course, be taken into account. Generally speaking, fast schedules can be made with weights of from 400 to 600 lb. per horsepower

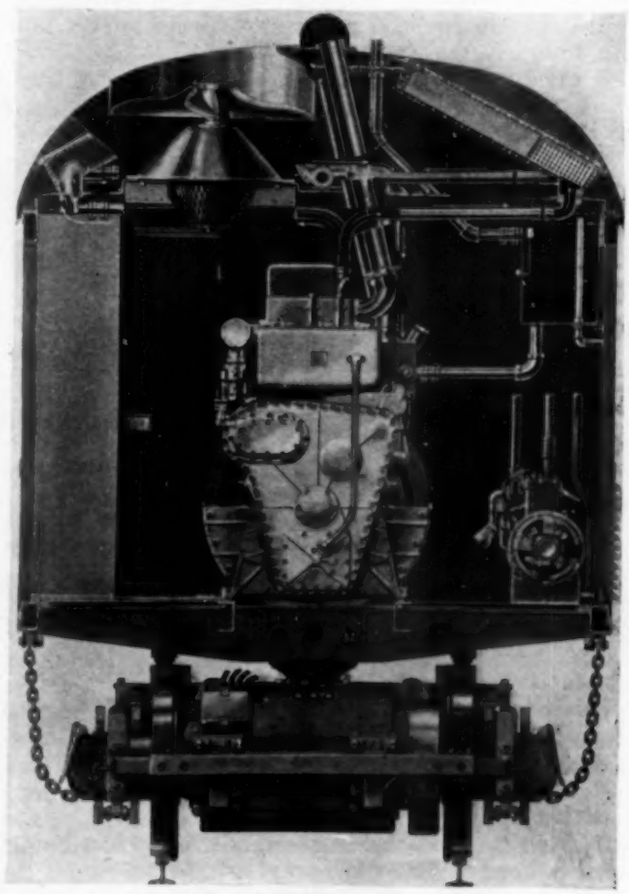


Fig. 1—Section Through Brill Model 860 Car, Showing Cooling System, Exhaust System, Front View of Main Engine, Location and Arrangement of Auxiliary Power Plant

and average schedules with weights as high as 1,000 lb. per horsepower.

The following is suggested as a simple and reliable means of rating:

For rail-car service, engines are to be rated at a speed which the manufacturer is willing to guarantee for continuous duty at 90 per cent of the actual power developed on test when operating at that speed. This practice has been followed by one prominent producer for several years, and has given uniformly satisfactory results; in fact, engines tested after 150,000 miles in service and previous to any overhauling have developed power somewhat in excess of the rating thus determined.

There has been a trend during the past several years toward increased operating speeds on internal-combustion engines of all kinds, particularly for automobiles, trucks, and bus service. This same trend should be followed logically in rail-car work. Considering that other things are equal, the power output of a given engine is more or less directly proportional to speed, it is obvious that the engine should be used and rated at the maximum speed consistent with satisfactory life and reliability. Increase in power from a given engine secured in this way does not increase the first cost materially either of the engine or the generator to which it is attached. It may be true that to operate at these higher speeds, the bearing loads are somewhat increased, but this is considered in bearing design, and is partly offset by careful balance and the use of aluminum pistons, thereby reducing reciprocating weight; in fact, when lightweight reciprocating parts are used and considering centrifugal, inertia, and gas-pressure loads, the net load on the bearings is frequently less at higher speeds. In any case, it is only necessary to provide adequate bearings. At the present time the limitation as to speed seems to rest more in satisfactory life and functioning of exhaust valves, than in bearing loads or piston speeds. The engines on the present market for this class of service vary in average piston speed from about 1,200 to 1,800 ft. per min. Engines using twin exhaust valves, thereby improving valve conditions, are ordinarily rated at about 1,650 ft. per minute.

Most Cars Designed for Gasoline

The vast majority of all rail motor-car engines in service are designed for and operate with gasoline as the fuel. At the present time, there is no power plant which can compete with the gasoline engine from the standpoints of weight, first cost, maintenance cost, reliability, and ease and flexibility of operation and control. Certain Western roads have adapted the carburetor engine to the burning of less volatile fuel, commonly known as distillate, by the use of special carburetors.

In a rail car, as well as other internal combustion engines, the need for regrinding exhaust valves is usually the first thing that makes it necessary to remove an engine from service. Therefore, anything that can be done to increase the life of exhaust valves materially increases the availability of the engine. Furthermore, the temperatures of the exhaust valves and exhaust-valve seats are largely responsible for limiting the compression which can be used, and, consequently, the power output and economy. The cooler the exhaust valves can be kept, the longer will be the time between regrinding periods. The heat of the valve head is dissipated primarily through the seat, and the greater the distance from the center of the head to the seat, the hotter will be the center of the valve head. Further, the area of the valve head exposed to heat increases with the square of valve diameter, whereas the cooling surface increases only in direct proportion to the diameter. Therefore, the smaller the valve, the more will be the cooling surface on the seat in proportion to total exposed area. These considerations have led to the use of twin exhaust valves in preference to one large valve, in most engines of more than 5-in. bore.

Twin intake valves are generally used, partly because they permit a higher volumetric efficiency due to more complete filling, but also because it makes possible interchangeability between intake and exhaust valves.

The majority of engines used in rail-car work are of the over-head-valve design, with the combustion chamber contained in the head. On most designs in general use, this combustion chamber is of a generally cylindrical shape.

Most Present Engines Are Satisfactory

Generally speaking, all engines on the present market are satisfactory from the standpoint of crankshafts, bearings, and oiling systems. It has been observed, however, that bearing replacements, when finally required (usually after 60,000 to 150,000 miles), are made necessary not by reason of excess wear, but rather because of the babbitt cracking loose from its support. This cracking almost invariably starts where anchoring dowels, screws, or rivets go through the bearing. Dowels and similar locating devices are also undesirable, particularly in the crankcase half of the main bearing, because it is impossible to remove the dowels, and hence a bearing for replacement without removing the shaft.

A suitable inter-cooler, or other provision, should be made for maintaining the oil temperature high enough to boil off as much dilution as possible, but low enough to prevent excessive oxidation of the oil. Satisfactory results have been had when the oil temperature is maintained between 150 and 170 deg. F. The use of a satisfactory oil filter is important. If good oil at the proper temperature is used, the matter of changing oil when using gasoline as a fuel is practically a question of contamination or dirt.

The cooling system should be designed so that the car will cool equally well when running in either direction and at any car speed, and should be such that the correct temperature can be maintained regardless of atmospheric temperature. This can be accomplished best by using forced-draft circulation of the cooling air through the engine radiators with electrically driven fans arranged for a variable-speed control so that the cooling capacity can be set to suit the conditions. The cooling system should be arranged so that all water automatically drains inside the car whenever the engine is shut down. This makes it unnecessary to drain the system to prevent freezing, as cooling water inside the car can be kept warm during layover periods by means of the car heater.

Various fuel-feeding systems have been used. None of them have been entirely satisfactory. Considerable work is being done to render the vacuum system less susceptible to derangement. If this shortcoming can be corrected, it represents the ideal system. There is also the possibility of using a series of small electrically driven pumps, so arranged that if one goes out of order the remainder will continue to function.

Design Factors of Commercial Airplanes

By CHARLES TALBOT PORTER
Keystone Aircraft Corporation

THE title of this paper was chosen to limit the discussion to large airplanes used for transportation. The term "commercial airplane" has in the past referred to any airplane that was not solely military in character, and this fact is a tribute to the extent to which the industry has in the past depended on the military services. In the future, this term should carry the same significance that the term "commercial automobile" conveys, and should be limited to those airplanes that are used in supplying transportation or some other business commodity.

The large commercial airplane really supplies transportation and is of value only when the commodity thus supplied can be marketed at a lower price for service rendered than similar service offered by the older and more established methods. This leads to an examination of the factors entering into the service rendered and their relative importance. These factors are speed, cost, safety, and comfort—and, most important of all, existing competition. This latter factor sets the standard that must be met or bettered to make operation an economic possibility.

Unfortunately, three factors, speed, comfort, and cost, are mutually antagonistic. At present the airplane cannot compete either in price or in comfort with the extra-fare train; hence, its only reason for being is speed. Therefore, this factor must be improved upon and given priority over every other consideration. Cost, however, increases very rapidly with speed and also with comfort and may become prohibitive if both these other factors are exaggerated.

The hardest problem for the designer is to get the proper relation between comfort and speed, assuming that the cost factor remains constant. Obviously, the maximum speed can be obtained by crowding a given number of passengers into as small a space as possible and having them "stay put," without giving them the various little accessories that contribute to their enjoyment. However, the class of passengers that can afford the high cost of air transportation is one that can afford and will demand all the conveniences of life.

It is generally claimed by air-transport operators that a cruising speed of 110 to 125 m.p.h. is necessary for successful competition with railroads. The term "cruising speed" is elastic and depends upon the revolutions per minute of the engines at which the pilot chooses to operate; hence, it is better to set up a criterion based on maximum speed. This figure may be set for the present at 145 to 155 miles per hour.

Having set up a high speed that must be equaled or bettered, the designer thus turns his attention to the size of body that must be provided. This will depend on the length of journey, but in general it may be assumed that flights of three to four hours will be the shortest in duration for which airplane use is justified. Each passenger will want a comfortably upholstered seat at least 20 in. wide, which should be adjustable at will. At the same time, he will require a certain freedom of movement, such as is afforded by getting up and walking around.

This requirement of mobility of action points to the development of large airplanes with a total capacity of 30 to 40 passengers. Several developments of airplanes of this type are now under way. Obviously, an airplane of large capacity can be operated at less cost per passenger mile than a small one, but when depreciation on capital cost is set up, will the resultant cost be a minimum for the very large airplane or for one of intermediate size? So important is this relatively unknown depreciation factor that it may control both the size of airplane and the materials of which it is made.

The present type of big transport is almost standardized as a high-wing monoplane, employing three air-cooled engines, one in the nose and two below the wing. This type has been a very logical development. Three engines are the minimum number on which satisfactory flight can be maintained with one engine out; hence, this number will probably remain the minimum for subdivision of power required. There is now, however, a campaign being launched to do away with the nose engine in order to reduce fuselage vibration.

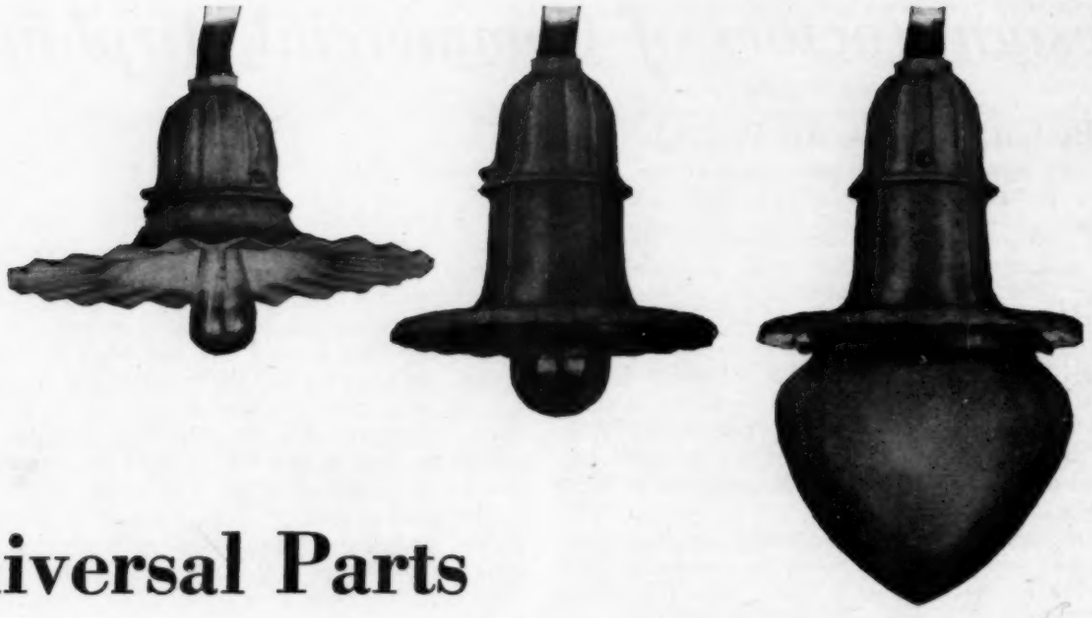
The present transports have a high speed of 135 to 145 m.p.h., with cruising speed about 110 m.p.h. This is probably a little low for transport requirements, but even this speed had been obtained only by the use of 100 hp. per passenger.

There has been much talk of the advantages of all-metal construction. This is as ridiculous as to talk of all-metal houses or all-metal row-boats as having some fundamental advantage over wood. In building houses, as in shipbuilding, there is some economic size limit where metal has universally superseded wood, and this also may apply to airplanes, but the engineer should select his materials for each case for the best combination of safety, durability cost, and performance.

Present transports have a variation in capital cost of from $4,000 to $6,000 per passenger. Present indications are that no very great reduction in these figures is likely as the size is increased.

Looking ahead, the author believes in the development of the 40-passenger airplane, but believes that present efficiencies must be improved and high performance obtained with an expenditure of 50 to 60 hp. per passenger. The first and most obvious step is to "clean up" the airplane and to increase the present propulsive efficiencies of the power plants. The most elegant solution of the engine problem is to house all the power plants in the wing itself and to have them geared in groups to shafts which have large propellers located at some distance from the engine room.

Next in line will come the increase in landing speed, and at the same time the development of very effective power-operated brakes. The pilot should have at his control sufficient braking force to develop the full friction between wheels and ground at all times. This braking force with improved long-stroke landing gears and possibly a spoiler system to kill the lift of the wing should make landing at 80 m.p.h. a safe operation on any prepared field.



Universal Parts

for Sales and Service Simplification

By careful redesign and co-operation with the sales department, more than 5,000 combinations were obtained, and easy maintenance was effected with only 42 parts in a product in which the customer demands variety and individual design

By R. G. BELLEZZA

Central Station Department, General Electric Company

STREET lighting with incandescent lamps has had its entire development during the last quarter of a century. It has grown up in a peculiar customer field where the thousands of municipalities and villages want individual customer attention and special design in the fixture itself, as well as in the layout. Local community pride has demanded street lighting effects that were different, usually with some argument of superior results in each case. This condition had resulted in a difficult manufacturing situation. Because of the very large variety of parts that had to be made in relatively small lots necessitating special dies and tools, little or no profit could be realized by the manufacturer on the original bid, and the replacement business could be kept up only at a sacrifice. It was impossible to stock parts for each customer without a heavy expense in overhead.

Fronted with the wastefulness of the situation, the sales and engineering units of the General Electric Company set out to make a complete redesign of the existing fixtures and suspension brackets and to attain such interchangeability as would give the maximum number of different fixtures with a minimum of separate parts that had to be stocked. This redesign study covered a period of two years during which time units were made and conferences were held with community engineers and the sales engineers of the company at the various sales offices throughout the country. These conferences resulted in suggestions for changes which were incorporated at the plant into the designs. As a final result of the redesign study, the total number of separate fixture hanger and bracket parts for the high- and low-tension fixtures, which were representative of the most difficult group, was reduced to 42, assembling into about 5,000 different types of fixtures. Whereas, previously, the fixtures were mongrel sets of accumulated parts, representing a high investment in stocks and costly replacements, the present combinations offer "universal" types that do not present the undesirable effect of "standardization" to the community yet can be produced without expensive manufacturing changes, and that can be maintained quickly and cheaply from few parts kept in stock. One added advantage gained by the redesign was the feature of capacity for expansion by using larger lamps in the same fixtures as the growth of the community called for better lighting.

The lighting group described in this article is for high- and low-tension circuits, that is, for circuits of any type or voltage. They are used for residential sections, highways, and secondary business streets. This class of lighting was originally done with 16- or 32-candlepower lamps on simple brackets, which were little more than markers in the streets. These, of course, called for nothing more than a lamp, socket, and reflector, but as the demands grew for lamps of 100 and 250 candlepower, the towns took more interest in the effect, so that the increased difficulty with varieties arose, as well as the added complications resulting from the increased voltage.

The story of the redesigned lamps is pictured in the accompanying illustrations. The initial unit of the

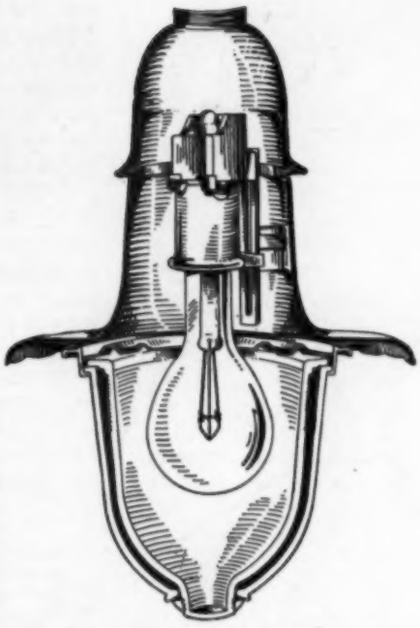
design is the hood. There are six final varieties of this part because of differences in the entry of the power, and different insulators for different voltages. The hoods are of cast iron, and the design was made so that simple changes in the patterns simplified the foundry work, and reduced the variety of castings. The bosses are made large enough, and are cored out to take the largest size of pipe tap, an adapter being furnished when the small size of pipe bracket is used. The hood casting was also made large enough to take the largest size of

Materials Used in Lighting Units and Brackets

Cast iron (gray iron)	Brass screws (standard commercial)
Sheet steel (low carbon)	Steel screws (standard commercial)
Aluminum (die cast)	Set screws (standard steel)
Felt	Cotter pins (standard steel)
Sheet copper	Lamps (standard commercial)
Bronze wire (spring)	Porcelain insulators (standard)
Porcelain sockets (standard units)	Wrought-iron pipe
Glass refractors (standard commercial units)	Soft steel strip
	Round soft steel rod

insulator bushing, and the opening for the reflector was standardized in diameter to fit the two varieties of reflectors or the insulators. These reflectors were made to fit either the hood or the insulator, depending on the type of fixture. Formerly, there was a wide variety of reflectors, but tests were made to demonstrate that all requirements could be met satisfactorily with only four varieties. Two of these are pressed from a special grade of enameling steel, and vary in diameter only, while two are of cast iron.

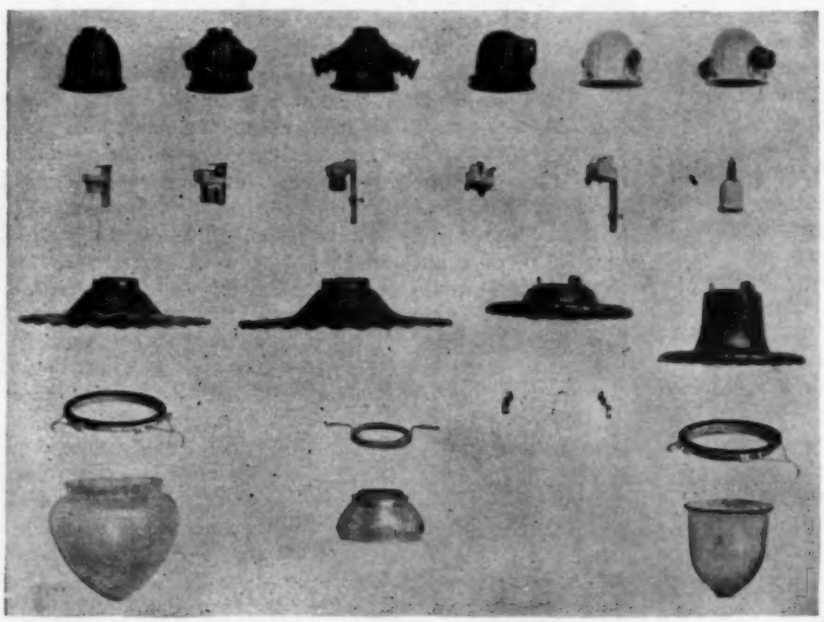
The finishing of the hood and reflector, which are the two exposed metal parts, originally offered one of the most difficult problems, because of the fact that customers asked for any one of an almost infinite variety of colors or finishes. After careful study, experiment, and sales "conferences" three finishes were chosen as standard: galvanized, green paint, and green vitreous enamel. The contour of the reflectors and hoods was designed primarily for light reflection, but also with the idea of providing a surface from which the enamel would not chip easily when exposed to weather for long periods of time. The sheet-steel reflectors are provided with a copper collar having tapered recesses into which the supporting screws enter, in order to relieve the enameled surface of any cracking strain. This, naturally, is not required in the cast-iron reflector. A gasket of felt is placed between the hood and reflector to provide a tight joint to prevent dust from getting in to the reflecting surface.



Sectional view of a "Novalux" street lighting unit showing how combinations are made

When it is desired to use refractors for the redirection of light, there are three types available: i.e., band, bowl, and dome. They may be used separately or in combination with one another and with an exterior inclosed globe. The globe band, or bowl, refractor is installed within a refractor holder which consists of a cast aluminum ring. To this ring are attached two spring supports, one acting as a hinge, and the other acting as a latch. The dome type is fastened within a treated holder. To the cast-iron reflectors, previously referred to, is fastened a hinge and latch lug when glassware is to be added. The band, or bowl, refractor and the globe, when mounted within their holders, are held tight against the reflecting surface of the unit by means of the spring hinge and latches supported by the hinge and latch lugs. A dust-proof seal is provided by means of a felt ring that is usually cemented to the upper side of the bowl refractor, or globe holder, and a similar seal is provided by the bowl refractor, or globe,

Universal Parts for Street Lighting Fixture Units



Eight standard lighting brackets and hangers that replaced an unlimited number of varieties called for by thousands of communities

and the holder. The supporting of the lamp sockets and insulators required a considerable display of ingenuity because of the variety of lamps and the different sizes that had to be provided for. An up and down adjustment was provided for lamps of different light center, and for different types of wiring. This was accomplished by using only six separate standard parts which made it possible to provide for internal or external wiring either within or without the hood for any length of light center.

The brackets and hangers were reduced to eleven parts, including the pole plates. With these, a great number of lighting effects are provided, but only two sizes of pipe are used—¾-in. and 1¼-in.—an adapter connection being used on the ¾-in. pipe to conform with the standard 1¼-in. hole in the hood. Previously, many sizes of pipes were called for. These brackets provide for adjusting the lamp units at different angles and positions, while the hangers permit arrangement of the units in various positions over the street.

The immediate effects of this simplification were that the customer could be furnished with any reasonable combination at once from a few stock parts, and he could be assured of obtaining replacement parts or additional similar units from the manufacturer's stock for immediate delivery at standard prices. An immediate jump in sales was the result, with increasing call for expansions that were not easy when the municipality had to order special units at high manufacturing costs. The effects on the manufacturer have been a lower cost for stocks, lowered manufacturing costs, and the possibilities of improving quality without burdening the shop. The design principles involved are not peculiar to this product alone, but are typical of what can be done by analytic design and by co-operation with the sales department and the customer.

Co-operation Between Drafting Room and Shop—*Discussion*

By J. A. Potter

Chief Draftsman, Singer Manufacturing Company, Bridgeport Factory

THE article by John F. Hardecker on page 193, Vol. 71, is in accord with my original article on page 45, Vol. 71. It is usually through the inspector working with the set-up man that manufacturing problems are presented to the drafting room.

It should be considered that, in all up-to-date plants, the usual method in handling jigs, fixtures, dies, and gages is to finish and inspect according to drawings in the toolroom. Some plants even go further and try out two or three parts in the new fixtures before they leave the toolroom to enter a manufacturing department. These methods consider the inspector and cover considerable ground in eliminating trouble, but do not remedy all the difficulties. An operator will not be as careful as the toolmaker. Large fins on steel parts may develop because of increased speeds and feeds, drills will not remain free from chips, and many other conditions in ordinary manufacturing routine demand attention.

Conditions in plants vary even as manufacturing methods do on a similar line of product. One plant may consider a run of 500 large and the other a lot of 50,000 small. Again, where limits of plus or minus 0.0005 in. are the rule rather than the exception, and limits of plus or minus 0.00025 in. are not at all unusual, it will be found that operators will try to keep on the high side for shafts and the low side for holes (a matter of protection to themselves on piece work). This is a condition which must be considered, not only in the detail of parts, but in the design of manufacturing equipment to produce these parts.

True, a drafting department should work on schedule and have the means whereby a set date can be met. One of the best methods is to maintain a balanced force, so that designers may do other work occasionally. This possibly may be called pinch hitting, but it is effective and eliminates the disturbance of hiring and firing. Steady employment is an inducement to good men, and the opportunity occasionally presented to work on a different line in design has been found to hold their interest.

It is not the intention to send Tom, Dick, or Harry into the shop on a manufacturing complaint, but to use the designer, squad leader, or one who is familiar with the particular job in view and who can best present the difficulty with all necessary details for immediate adjustment. There are two sides to most problems. Sometimes one side is only a matter of opinion which will clear the situation if explained.

The ultimate aim, of course, is to make a drawing with necessary notes so clear that there will be no necessity for questions. Until this can be done, it will be far better for the drafting department to furnish such information as chord distances between holes, gears for special hobs, additional angles for setting up, and other simple data which can be quickly calculated by the drawing room.

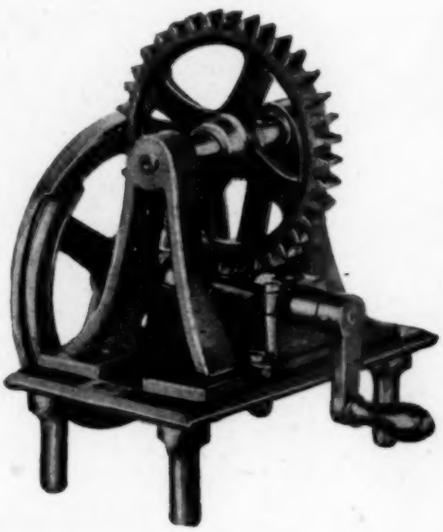
Some drafting rooms use a drawing as an engineering record rather than as a shop work plan. In a well regulated plant it is not necessary to place engineering data and unnecessary calculations on a working drawing. This data is always available in the files, if needed.

Mechanical Movements

Useful in Design

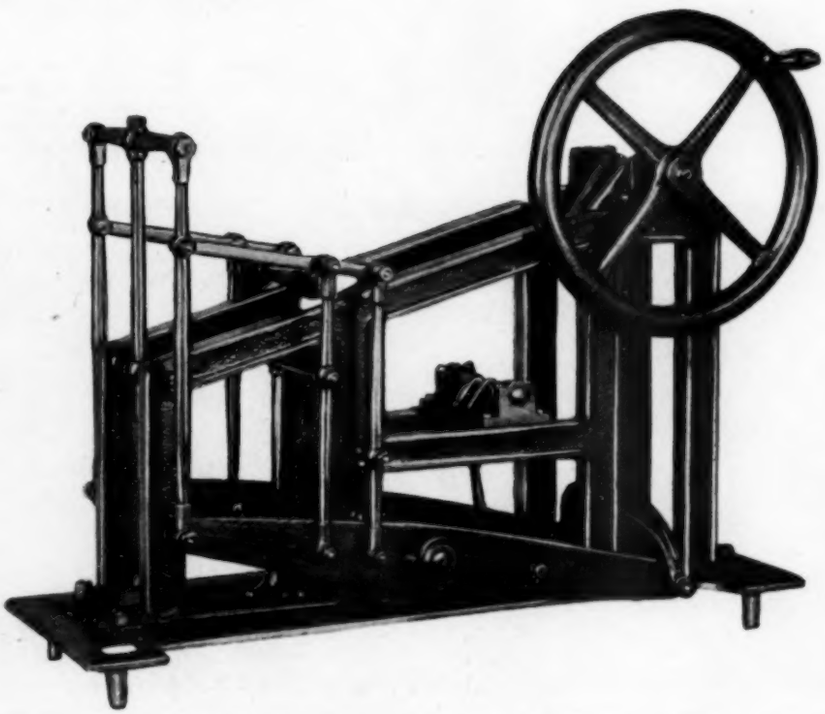
Photographs by courtesy of the Museum of the Peaceful Arts, New York. Models are the property of the Sheffield Scientific School, Yale University, New Haven, Connecticut.

Three systems which may be incorporated in a variety of machines as motion-transmitting units

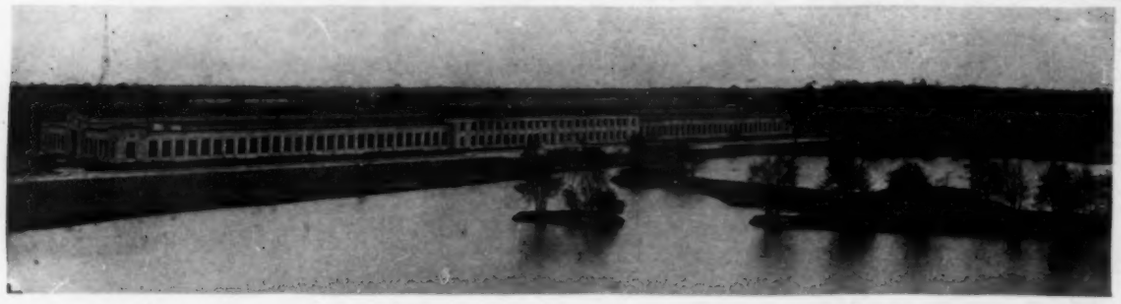


Upper left — A reduction motion utilizing a one-tooth pinion. The shafts are perpendicular to each other, the upper shaft moving one tooth for each turn of the crank. The ratio is 36 to 1

Upper right — An adjustable link drive with one shaft which may be slid sidewise. When the shafts are in line, they will transmit uniform motion. As one shaft is slid to the side, the motion becomes increasingly irregular, until, when the shafts are one crank-length apart, the mechanism ceases to be positive in action



At the left—A link motion of an old-style, side-wheel marine engine. Various combinations of parallel motions are indicated. For example, the motion of the parallel rods at the extreme left of the illustration consists of an up-and-down motion of the lower extremity, a circular motion of the upper extremity, and a combined rocking and sliding motion at the center



The Ford Engineering Laboratory and its attractive setting

Where Ford Engineering Is Done

Few commercial plants have development work conducted under such ideal conditions, yet the general plan might readily serve as a model for smaller concerns

ENGINEERING and development work of the Ford Motor Company is conducted, and all designs relating to the Ford and Lincoln cars, Ford trucks and tractors and Ford airplanes are originated and the resulting or preliminary experimental work is carried out in a laboratory unit at Dearborn, Mich. Here also Henry Ford and his son, Edsel Ford, spend much of their time in personal supervision of new developments which they sometimes initiate personally.

The accompanying photographs give a comprehensive idea of the engineering building, located in the outskirts of Dearborn adjacent to the Ford airport and the new Ford engineering museum. This building, with the exception of a small two-story portion at the front, which houses executive offices, is a single-story structure the main section of which has a floor area 200 ft. wide by 800 ft. long. Most of this area is in a single room the greater part of which is not divided by partitions. The dotted lines in the floor plan shown merely give the approximate and frequently altered boundaries of areas occupied by different groups in the engineering organization. Back of this main building and connected with it, but not shown in plan or photographs, is another modern building of almost equal size, used primarily as a garage for cars and trucks undergoing test, cars belonging to employees of the laboratory, a cafeteria, storage, and

The main entrance to the laboratory building is in keeping with its purpose, and is impressive from an architectural standpoint

An interior view of the main laboratory building. A part of the excellent experimental shop equipment and the unusual roof and skylight arrangement are shown

other purposes. Each of the five bays across the main width of the building has a sloping-side monitor roof extending the full 800-ft. length. At each side of each monitor are inclined skylights which afford perfect lighting. Motor-operated Venetian blinds with push-button control are used to cover these skylights when sunlight is too strong. In the central bay the skylights are about double the height of those in the side bays, and a craneway runs the full length. The entire floor is of polished hardwood kept as clean as that in a ballroom, for it is a part of the Ford policy to maintain all buildings, including those used for manufacturing, as nearly spotless as possible.

A view of the well-equipped metallurgical laboratory. Against the wall in the background is a group of antique containers, such as once adorned the windows of apothecaries' shops, assembled by Mr. Ford for later exhibit in his new museum

Nine divisions, most of which carry on both design and experimental development work, are housed in the laboratory building. They are the Ford Chassis and Ford Body, Lincoln Chassis and Lincoln Body, Tractor, Airplane, Electrical, Special Design, and Blueprint and Record Divisions. The approximate area occupied by each division is shown on the floor plan. Each division has an engineer in charge, an assistant engineer, a chief draftsman, and such other personnel as is required. There are also several engineers who work on special problems and executive matters directly under the Fords themselves. Henry Ford makes chassis his special concern, while the son pays particular attention to the body end of the business.

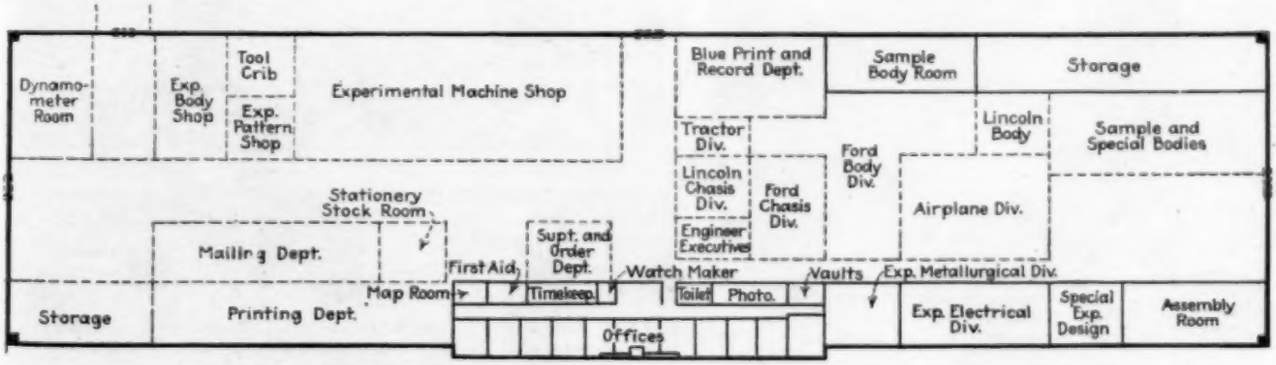
Because of the greater magnitude of the operations involved, the groups working on the Ford car are relatively large, but men normally attached to one division frequently are shifted temporarily into another when the pressure of work demands, or when the special experience they possess will prove of particular advantage. Thus, for example, an automobile body designer may be called upon to work out a problem in airplane cabin design, while a specialist in aircraft work may be shifted onto chassis design, as occasion requires. This flexible arrangement is not only profitable to the company, but reacts to the advantage of employees, since good men who are willing to adapt themselves to work outside their normal round rarely are laid off when work in their own department happens to be slack.

Besides the departments named above, the engineering building houses exceedingly well-equipped shops for experimental wood and metal construction work, metallurgical, electrical, and dynamometer laboratories, several smaller departments for specialized work, and a printing department. The last-named department, however, occupies some space not now required for engineering work, and is not a part of the engineering organization. The shop facilities comprise machines for practically all operations needed to build complete vehicles, including sheet metal, wood and other parts. There is also an experimental pattern shop.

Each of the several design departments makes such requisitions for material and shop work as may be needed and assigns men to follow up both the construction work and the experimental tests required to perfect the new part or mechanism.

As the accompanying floor plan indicates, a considerable proportion of one end of the main building is given over to the designing activities. Each division has its own draftsmen who enjoy, not alone ample room and ideal light in which to work, but the most modern equipment, including stools with adjustable backs that enable work to be done in as comfortable a position as possible, thereby reducing fatigue. There are also, adjacent to each drafting group, chassis, complete cars, tractors or trucks and numerous parts thereof, available for study and measurement in effecting improvements. Many sample and display bodies are kept in or close to the body designing departments.

One of the few areas divided off by partitions is the room in which special experimental and confidential designs are worked out. This happens to be adjacent



Floor plan of the main building which is 800 ft. long and 200 ft. wide. Partitions are shown in full lines

to two other rooms also divided by partitions from the main floor area, namely the electrical and metallurgical laboratories, both of which have the most modern equipment.

Special facilities for producing and filing duplicate tracings as well as blueprints and photostats are maintained in the Blueprint and Record Department, which is convenient to all designing departments as well as to the experimental shops. The latter are located, however, in the opposite half of the building from the drafting sections, so that any shop noise is not disturbing.

Still further removed from the sections in which designing is done is the dynamometer laboratory where engines and other parts are subjected to running tests. Other tests, especially those involving considerable noise, are made in a section of the garage building adjoining the main building. There also are facilities for assembling and dismantling test cars and trucks and for making such examinations and adjustments as are required between road tests. Every day a car fresh from the production lines in the River Rouge plant is brought to the laboratory garage and subjected to such tests as are necessary to see that it meets required standards.

That part of research work involving a study of current and past writing on engineering subjects has not been overlooked, for on the second floor of the office section of the building is a well-equipped library containing files of current engineering periodicals and numerous reference books. There also are files of publications needed for making patent searches. In addition, the library has arrangements with Detroit and Dearborn libraries for securing practically all books or other publications not included in its own files.

Thus it will be seen that the Ford Motor Company, known the world over primarily as a colossal production organization, has back of its manufacturing facilities an engineering and research laboratory comparing favorably with those of other great manufacturing concerns.

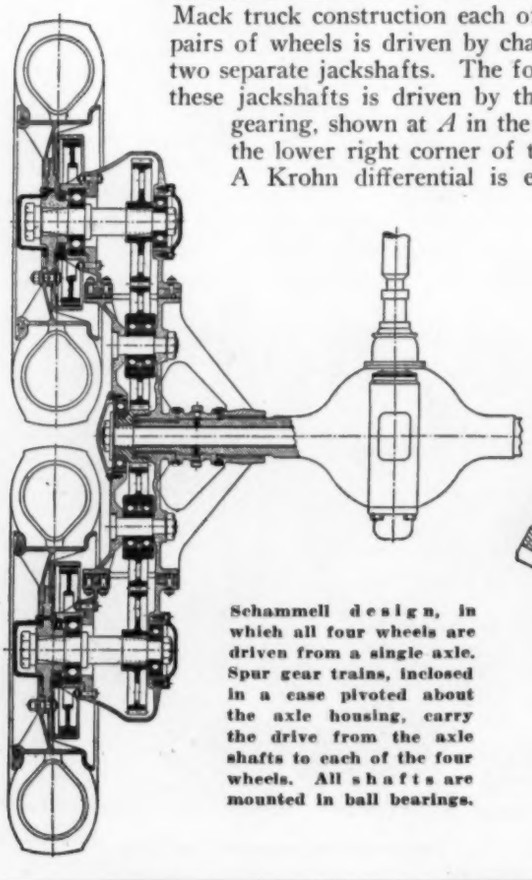
Six-Wheel Vehicle Design

IN THE application of the four-rear-wheel drive to six-wheel vehicles, the axle builder is interested in the type of spring mounting, the method of taking the torque, and the distribution of the load. In discussing several of these phases at the Transportation Meeting of the S.A.E. in Toronto, Nov. 12, 1929, Austin M. Wolf stated that among the important units required in vehicles of this type are those for transmitting the drive to each of the four rear wheels. In the Mack truck construction each of the two pairs of wheels is driven by chains from two separate jackshafts. The forward of these jackshafts is driven by the hypoid gearing, shown at *A* in the figure in the lower right corner of this page. A Krohn differential is employed. Power from the engine is conveyed to the forward pinion by means of a sleeve and rearwardly through the tailstub to the second jackshaft.

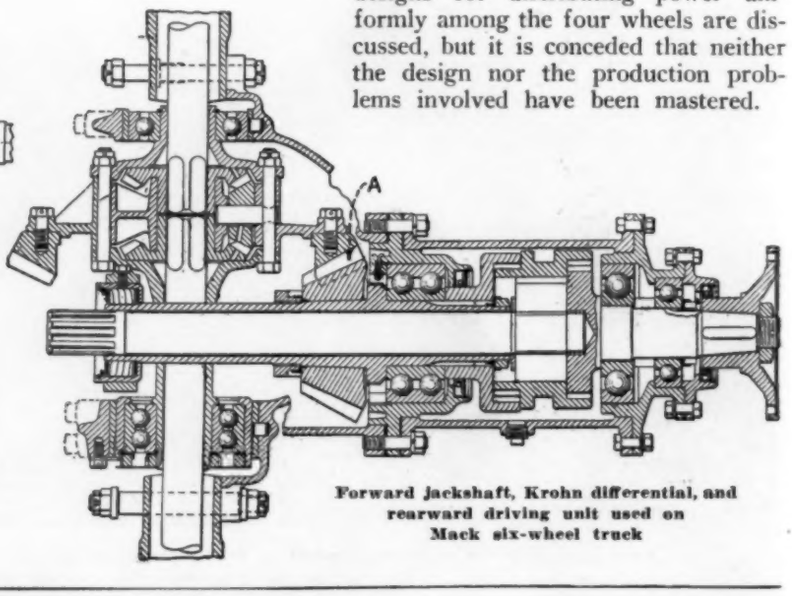
A quite different arrangement is that used in the Schammell truck, which, as shown in the drawing at the left, employs a single axle for all four wheels. At each end of this axle is a gear case pivoted on the axle housing, the drive to each wheel being through a train of spur gears.

Another paper, entitled "Four-Wheel Drives for Six-Wheel Chassis," presented at the same meeting by L. R. Buckendale, executive engineer of the Timken-Detroit Axle Company, discusses the methods of spring suspension to distribute the weight properly among the four rear wheels, to provide for their movement vertically, and to keep the driving axles parallel to each other and in correct alignment with the chassis frame.

Difference of opinion exists as to the desirability of employing a differential between the front and rear driving axles. Alternative experimental designs for distributing power uniformly among the four wheels are discussed, but it is conceded that neither the design nor the production problems involved have been mastered.



Schammell design, in which all four wheels are driven from a single axle. Spur gear trains, inclosed in a case pivoted about the axle housing, carry the drive from the axle shafts to each of the four wheels. All shafts are mounted in ball bearings.



Forward jackshaft, Krohn differential, and rearward driving unit used on Mack six-wheel truck

IDEAS FOR ENGINEERS

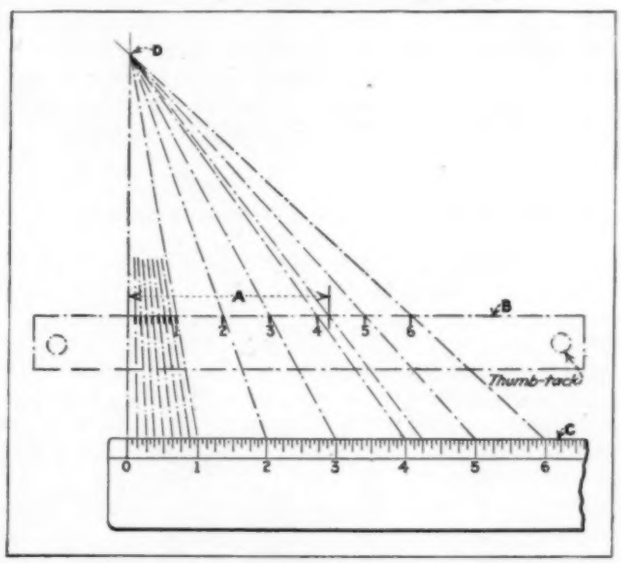
The department, "IDEAS FOR ENGINEERS," is devoted to the exchange of information on methods useful to the machinery industries. It includes all divisions of engineering practice, from design problems to engineering equipment. Descriptions of methods or devices that have proved their value are carefully considered, and those published are paid for. The rates are from a minimum of five dollars upwards, depending upon their merit.

A Scale for Unscalable Drawings

BY PETER HAGEN
Department of Engineering, U. S. Navy Yard, Philadelphia

Occasions arise in the drafting room and the shop, when it is desirable, and even necessary, to scale photostats and drawings received from outside sources. Photostatic copies of drawings are seldom reduced to a convenient or workable scale, and it is a dangerous practice to scale important dimensions.

Perhaps, the greatest difficulty is encountered when a draftsman desires to revise, or add sections and details to, a print of foreign origin, possibly in metric



Proportional scale for scaling photostats, or metric drawings

dimensions. In some cases proportional dividers may answer the purpose, but usually this is a laborious and unsatisfactory method.

As a solution of these difficulties, I offer the simple method of making a proportional rule that will be accurately calibrated to the scale of the drawing or photostat, as shown in the illustration.

In practice, any convenient dimension is selected from the drawing to be scaled. In this particular case, the dimension is assumed to be 4¼ in. Its actual measurement, 3 in., is transferred to a rectangular strip of cardboard, with a pair of dividers, as shown at *A*. For convenience, the cardboard strip should be thumb-tacked to the drafting board.

At any distance below the line *B*, and on a plane parallel with *B*, a standard scale is laid in such a position that its zero dimension will be directly below the left point of the dimension *A*. A vertical line is drawn through these two points. A second line is then drawn from a point on the standard scale, equivalent to the dimension *A*—in this instance, 4¼ in.—through the right point of the *A* dimension on the cardboard scale. From the point where the two lines converge, at *D*, lines may be drawn through other dimensions on the standard scale, and they will be proportional on the cardboard one.

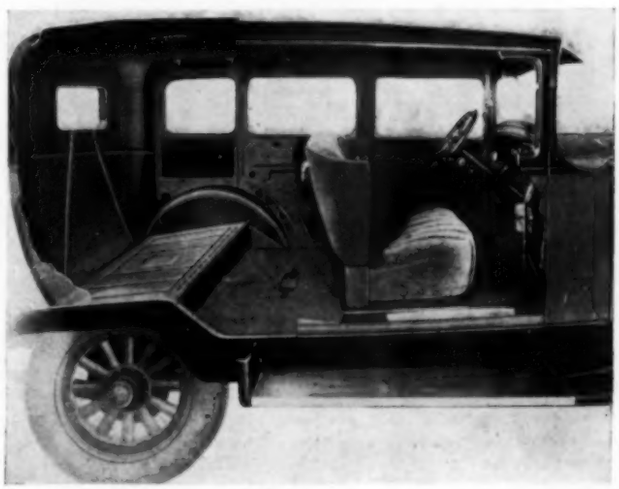
A Blackboard in the Drafting Room
Discussion

BY W. R. NEEDHAM
Engineer, Design Department, English Electric Company, Ltd.

As Roy E. Peterson suggests on page 259, Vol. 71, of the *American Machinist*, the blackboard can serve a highly important purpose in the drafting room. It has, however, several uses in addition to those which he suggests. A leading company in Great Britain uses such a board for holding long developed layouts ("processions," as they have been facetiously called), thus making it possible to examine a design as a whole instead of by sections. If the design had been laid out on the floor instead, as is sometimes done, much inconvenience would have been erased because of persons passing and repassing, particularly because of the narrow aisles.

A One-Piece Welded Automobile Body

Unusual gains in strength and rigidity have been made by the use of one-piece welded construction in the new Dodge Six bodies which have been entirely redesigned to take advantage of the advances made in welding and



Cut-away view of a Dodge Mono-Piece body, showing interior constructional details

stamping practice. Recent use of larger dies has reduced considerably the number of component parts necessary in the body assembly, while new methods of welding have made it possible to join parts together so that there is no line of weakness at the joint. The result is greater strength and elimination of body screech and rattle, which have taken so much joy out of driving in the past. The body is known as the "Mono-Piece" type. It goes a step beyond anything previously done in the establishment of complete continuity of body structure. The absence of riveted joints and the continuity of parts above the pillars and in the front and rear corners are especially noteworthy.

Tight Terminals for Meters

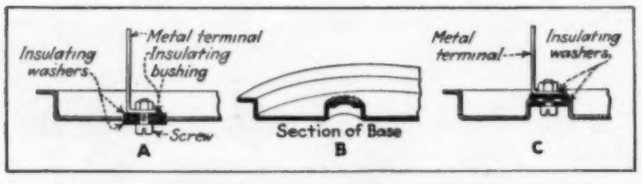
By Charles H. Willey

Asst. Plant Superintendent, Hoyt Electrical Works

A worth-while saving has been made in a simple, yet effective, change of design in the metal bases of our radio meters. Much trouble formerly resulted from loose terminals after the meters had left the factory. Customers, in soldering on lead wires, naturally heated the terminals, and the insulation washers would loosen as a result of this heat. Other meters returned showed that the terminal had been turned with pliers to another position to suit the fancy of the owner.

The original design, shown at *A*, called for a plain flat base, with a hole of sufficient size to put in the insulating bushing, washers, and the screw and terminal.

By changing the design of the base around the hole to that shown at *B*, with the hole in a recess, the bottom of which was corrugated, further troubles were avoided. The assembly adopted is shown at *C*. The recess cen-



Details of Hoyt meter base showing the original design, *A*, and the improved design, *B* and *C*

tered the washers, making it unnecessary to employ a bushing in the hole, while the corrugation gripped the surfaces of the washers and prevented them from turning.

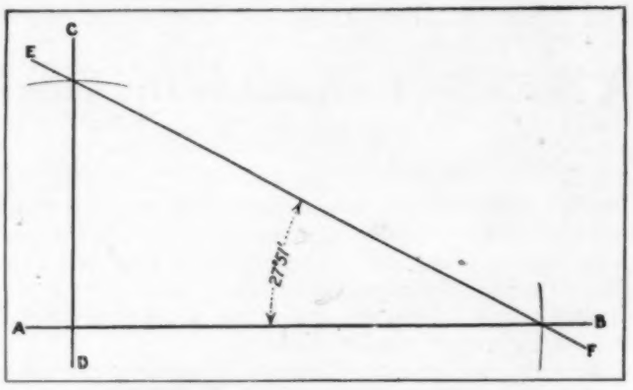
Laying Out an Angle Without a Protractor

By Don R. Hammitt

Chief Engineer, Portland Forge & Foundry Company

In addition to affording a means of laying out an angle without a protractor, the following method will be found to give much more accurate results. This is true, particularly, where it is necessary to measure to minutes. The equipment required consists of an ordinary draftsman's scale, a square, a pair of compasses, and a table of natural tangents. The last may be found in most handbooks or in a book of mathematical tables.

The method of laying out an angle is as follows: Select from the table of natural tangents the tangent of the angle required, for example that of 27 deg. 51 min. This value is 0.52836. Next lay off a horizontal reference line *AB* at least 10 in. in length. At a point near the left end, erect a perpendicular *CD*. From the intersection of *CD* and *AB*, lay off any convenient length, such as 10 in., to the point *F*. Since the tangent of an angle is the quotient of the opposite side divided by the adjacent side, it is evident that if the 10-in. horizontal length is considered as the adjacent side, the opposite side on the perpendicular must be 10 × 0.52836, or



Showing how an angle may be laid out by the use of the natural tangent to proportion the opposite and adjacent sides in a triangle

5.2836 in., or $5\frac{9}{32}$ in. After laying this distance off to *E*, connect the two points *E* and *F*. The triangle is now complete, and the angle of 27 deg. 51 min. is correctly laid out, as shown, with a high degree of accuracy.

Unusual Worm Gear Mounting

Answer to Reader's Question

Q. I am contemplating the use of a set of worm gearing to the following specifications: Worm, 14 threads, 4 d.p. to 1½ d.p., 45 deg. Load to be that allowable for spur gears by Lewis formula, but this load to cover about 30 deg. of the gear. The rest of the time the load is nominal. The velocity at the pitch line will be 300 ft. per min. for the 1½ d.p., or 500 ft. per min. for the 4 d.p.

The reason for using this set-up of gears is to obtain a 90-deg. angle between the axes, and an offset between the axes. It is my understanding, that a train of gears such as these, if properly cut and mounted, should be efficient and durable.

A. The following solution is offered by Prof. Earle Buckingham: As far as the strength of the gear tooth as regards breaking under load is involved, the Lewis formula is satisfactory. In this case, with a peak load always concentrated on the same part of the gear, the critical feature is its ability to withstand wear. For a bronze gear, and pitch line speeds of 500 or 600 ft. per min., the load per inch of face per inch of diameter of the gear should not exceed about 75 or 80 lb. if a reasonably useful life is desired. Thus, if the gear were about 20 in. in diameter with a 3-in. face, the maximum tooth load would be about 75x20x3 which equals 4500 lb. This data is an approximation based on the results in service of other worm drives. The A.S.M.E. Special Research Committee is working on this problem and hopes to be able to develop more reliable data in the not distant future.

Typical Oil-Hole Covers

OIL-HOLE covers are most useful for keeping dirt and grit out of bearings and for calling attention to the point to be oiled. Oil-hole covers differ from oil cups in that they are of approximately one diameter throughout their length, and do not have a cup much larger than the hole diameter for retaining a quantity of oil, although they sometimes are made large enough for this purpose. Most covers are furnished in mechanical nickel-plate finish, although plain or polished brass and steel covers are also available.

In Fig. 1 are shown several styles of oil-hole covers with spring-hinged lids. The lids are arranged so that they may be opened easily with an oil-can spout, and are self-closing. This style of cover may be made dustproof by the addition of a leather packing. A small felt plug placed in the opening serves as an oil retainer and feeds the oil gradually. The felt should be $\frac{1}{16}$ in. smaller in diameter than the hole in the body and but three-quarters of its length. Space requirements, or overall diameters, for commercial covers of this style run from $\frac{1}{2}$ to $3\frac{1}{16}$ in. in diameter, the larger covers often being used as filler caps for large tanks and reservoirs. They are also made with an inside thread for connecting a nipple or pipe extension to them or, as in *b*, for reaching distant bearings. Covers are available with either S. A. E. or pipe thread in standard sizes, as in *a* and *c*.

Drive types, similar to *d* and *e*, suitable for driving into standard copper tubing or for clinching over sheet metal after driving through, are available.

Lifting the head of the type shown in Fig. 2 uncovers the oil hole or a hole in the side of the shank, as shown. A spring closes the head, making it dustproof. In addition to the threaded types shown, drive types are furnished. Lift-top covers, utilizing a cylindrical sleeve cap, are also made, either with or without a knurled sleeve, and with a drive or threaded shank. The top is lifted with the oilcan spout and snaps back into place automatically when released. This type may be used in a horizontal position where side oiling is necessary.

Revolving-sleeve types, Fig. 3, are dustproof and may be used in either horizontal or vertical positions, the sleeves being held shut by a spring. Assembly clearances, or space requirements, range from $\frac{7}{32}$ to $\frac{5}{8}$ in. in diameter. This type is handy for loose pulleys because, when the cover is open, the pulley may be held with one hand and the oil can with the other. The threaded style is supplied with a slot.

Ball-valve types, such as shown in Fig. 4, require a minimum of clearance for the head, the driven type of cover, illustrated in *b*, fitting almost flush with the surface. This type is self-closing, practically dustproof, is easily opened with an oil-can spout. It is furnished also as shown at *c* with a larger oil reservoir.

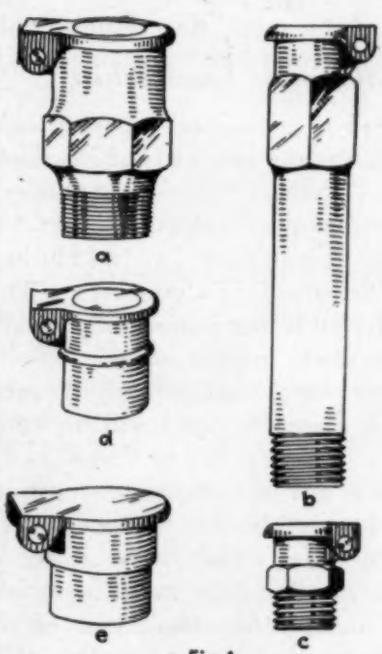


Fig. 1

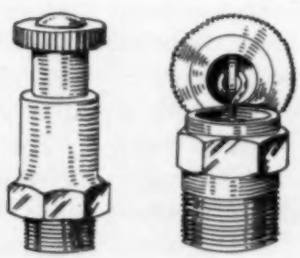


Fig. 2

Fig. 3

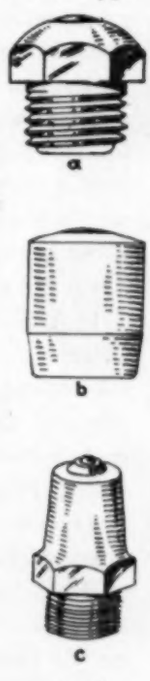


Fig. 4

Fig. 1—Spring-hinge-lid oil-hole covers. At *a* is the usual threaded type; at *b* the type for reaching into inaccessible holes; at *c* the type for use where overhead space is limited; at *d* a drive type with head; and at *e* a drive type with shoulder. Fig. 2—Lift-top covers, showing only threaded types. Fig. 3—Revolving-sleeve covers. Fig. 4—Ball-valve cover. At *a*, threaded type for limited overhead space; at *b*, drive type, also furnished with shoulder; and at *c*, large oil reservoir type. All ball types are easily opened with an oilcan spout, and are self-closing.

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Editors: KENNETH H. CONDIT AND FRED H. COLVIN

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Product Engineering

IN MODERN industry the place filled by the product engineer is one of paramount importance. His task is to design and engineer a product that can be sold to a critical consumer, and that can be made at a reasonable cost. He stands between the conflicting demands of the sales manager and the chief of manufacturing, and he reconciles their divergent points of view in a product that is also satisfactory from the engineering aspect.

Product engineering, although recognized by that term only recently perhaps, has always been an essential function in industry. But of late it has demanded a steadily increasing amount of recognition by reason of the changes that are taking place in manufacturing and distributing processes.

The metal working field is typical of what is going on elsewhere. It is not only typical, but to some extent prophetic of what is to come in other industries. Scientific management had its start in a metal working plant. Materials handling has been more highly developed in metal working plants than in almost any other field. And product engineering is developing more rapidly in those plants, and consequently is most in need of adequate editorial service.

In August, *American Machinist* began improving its service to the product engineer by publishing in the second issue of each month all of the engineering and design material that had formerly been distributed through all issues. These issues were called Product Engineering Numbers, and they have been received with marked favor by engineering readers.

The time has now come to make a further advance. About four weeks hence the first number of *Product Engineering* will be published as a new McGraw-Hill paper. In general content it will be not unlike the current Product Engineering Number of *American Machinist*. Its appearance, however, will be distinctive, and it will be independent of its parent paper except that it will have the whole editorial staff of *American Machinist* to draw upon for advice and for assistance when assistance is needed. The value to a new periodical of the experience of a seasoned editorial staff like that of *American Machinist* can hardly be overestimated. In addition, field contacts will be much more numerous than would be possible with the staff a single monthly paper could support.

Product Engineering, as a McGraw-Hill paper, will have the editorial staffs of twenty-seven other McGraw-Hill papers to draw upon for suggestions and for leads from their respective fields. And, it will have, of course, the effective aid of the McGraw-Hill executive staff organization to help it get started on its way. It will be launched, therefore, with every publishing advantage, and will need only the frank criticism of its readers to insure its success.

The opportunity for this new paper to provide inspiration and solidly practical working information is unequaled. It is clearly recognized by the editors, and their aim will be, therefore, to make the most of it by combining thought-provoking articles and editorials with the hard facts and technical data necessary if metal products are to be developed to the utmost, and product engineers are to occupy their rightful place in the manufacturing plan.

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Politico-Business Leadership

THE formation of a business advisory committee, which was the result of the Washington conference of December fifth, is a logical step in the national economic development that has been progressing cumulatively since Herbert Hoover became Secretary of Commerce. This step was inevitable, but it was undoubtedly greatly hastened by the stock market upset. If the achievements of the new group approach its potentialities, that most expensive upset will be worth all it cost.

This new business advisory committee must not be misinterpreted as a gigantic economic wheel chair for tired businesses. Such is clearly not its purpose. It will function only as business men incorporate the sound recommendations of the committee into their own businesses and do their own daily work every day. Though the best business brains of the country have been selected for the committee, they can hardly be expected to be infallible in anything as new as this.

If this experiment in politico-business leadership is as successful as it promises to be, it represents one of the most important advances in the history of social progress.

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Two Kinds of Research

RESEARCH is much heard about these days. Systematic study of fundamentals is now doing for engineering what it has done for pure science for many years. But fakers and well-intentioned over-enthusiasts are likely to be found everywhere, and if we are to save true research from the black eye that scientific management received from the operation of the "efficiency bugs" only a few years ago we must distinguish, at the outset, what is and what is not research.

Research that is going to amount to anything requires patient, sometimes heart-breaking study by men who have a background of training and who are open-minded enough to recognize adverse factors as well as favorable ones. So-called studies by untrained clerks and enthusiasts who are prone to seek only the favorable points to boast about and hide or ignore the unfavorable, is not research, no matter under what label it works.

Too much sales engineering research is beginning to fall into this category. It should be killed at its inception. Far better for the firm that wants to get the best out of its product to search out the bad points and throw them back on the designer or into the shop for improvement. The resulting product will then be something truly worth boasting about.

*

Incentives for Designers

DESIGNERS and engineers are about the only individuals directly connected with the manufacturing operations in a modern plant who are not urged on by some form of financial incentive. Perhaps they should take pride in this distinction, but pride pays no rent bills.

All sorts of wage incentive plans, from straight piece work to elaborately graduated bonus systems, have been applied to the man at the machine to urge him to his best efforts. The supervisory staff members often share in the savings made by their departments, or in the profits of the enterprise.

The sales force, of course, works almost entirely on at least a part-commission basis. The younger men may perhaps receive salaries until they become established, but after that point is reached they expect the opportunity of earning in proportion to their efforts.

Why not consider the designing engineer as being sufficiently human to respond to the kind of incentive that works so well with the production and distribution forces? Who knows what developments might be brought to earlier fruition if the designer could see in his work a real step toward economic independence?

In some really advanced organizations the engineering department has been given its chance along with production and sales, but in the great majority of companies the patent allowed for the really ingenious work of design is signed over to the employing corporation, by agreement, and the man responsible must be content with his generally inadequate salary. Perhaps he is of sufficiently professional a mind to be above incentives that would add to his own comfort and security; probably not.

*

The President's Message

PROBABLY no presidential message was ever scanned with more eagerness by men of all political parties than was that which President Hoover delivered to the Congress last week, chiefly because of the expectancy with which business of all kinds is looking at the present time to the government for guidance. Advances in the stock market following the publication of the message in the morning papers were attributed by the daily press of the same evening to the statment of confidence in business and in the economic condition of the country shown throughout the message.

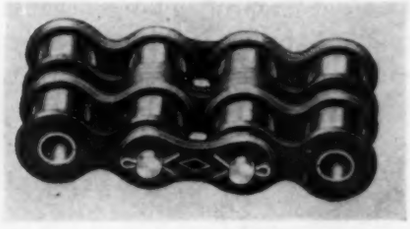
Economy in governmental operation, removal of the uncertainty concerning tariffs and railroad and marine operation were among the points of outstanding interest to business executives. That the President is determined on governmental economy and efficient departmental reorganization is encouraging. It was possibly asking too much to expect the executive to hurl himself into the maelstrom of tariff bickering that has been worrying Washington since early summer. But his restatement of his initial position was plain and positive —speedy action and only limited tariff changes are asked. The government position on the railroad mergers is also made clear, and is likely to bring a confidence that will permit going ahead on betterment and new equipment programs.

NEW MATERIALS AND PARTS

And Engineering Equipment

Diamond No. 480 2½-Inch Pitch Roller Chain

To meet the demand for larger pitch roller chain, the 2½-in. pitch chain shown in the accompanying illustration has been developed by the Diamond Chain & Manufacturing Company, Indianapolis, Ind. This chain conforms to the A.S.M.E., S.A.E., A.S.M.A., and the American



Diamond No. 480 Double-Strand 2½-Inch Pitch Roller Chain

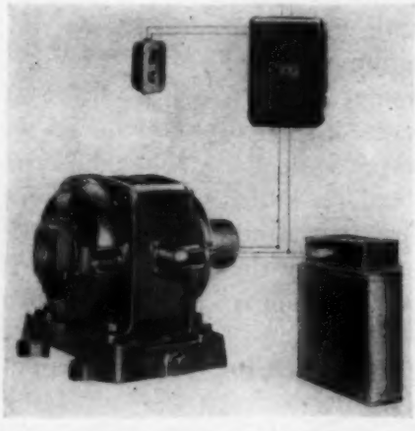
standards. It is similar in design to other roller chain manufactured by the company, but is made for heavy-duty applications, such as large conveyors and industrial locomotives. For single-strand chain, the average tensile strength is 95,000 pounds, maximum horsepower, 97 with a 19-tooth sprocket, and maximum speed, 240 r.p.m. The chain is made in single and multiple strands, the transmission capacity and tensile strength being proportional to the number of strands.

"Ermalite" High-Strength Wear-Resistant Cast Iron

A cast iron, known as "Ermalite" and having a structure consisting of a pearlitic matrix in which graphite particles are distributed evenly and with practically no free cementite, has been placed on the market by the Erie Malleable Iron Company, Erie, Pa. The material has a finer grain than the usual cast iron and is claimed to have good wearing properties, so much so that it is specified for brake drums. Its tensile strength is approximately 60,000 lb. per sq.in. The transverse strength of a 1-in. round bar on 12-in. centers with a load applied at the middle of the span is 6,500 to 7,000 lb. and the deflection ranges from 0.35 to 0.40 in. The Brinell hardness ranges from 240 to 250, but the material is not brittle. The company claims that the graphitic content makes the surface wear smoothly, and that a high coefficient of friction is maintained throughout the life of a brake lining.

General Electric Type KC Single-Phase, Squirrel-Cage Capacitor Motors

A line of single-phase squirrel-cage capacitor motors, designated as type KC and especially designed for quiet operation, has been placed on



General Electric Type KC Single-Phase, Squirrel-Cage Capacitor Motor

the market by the General Electric Company, Schenectady, N. Y. These motors are suitable for driving blowers and ventilating fans, and for use on centrifugal machinery, low-pressure pumping applications, woodworking machines, and machine tools where the motor is built into the machine.

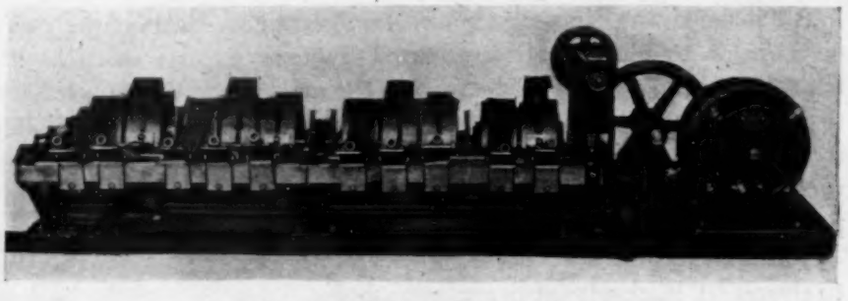
Although the KC motor is classified as a single-phase type, it is really a modified two-phase, squirrel-cage motor having a capacitor in series with one phase of the stator windings. This gives starting characteristics similar to the two-phase squirrel cage motor; that is, it is self starting. The capacitor remains in the circuit throughout starting and running so that full-voltage hand or magnetic control only is required. As a result of this, single-phase pulsation is absent. In addition, special slot combinations and rotor construction are used to obtain quiet running.

The constant-speed ratings available are from 1 to 25 hp., inclusive, at 3,600, 1,800, 1,200 and 900 r.p.m. with starting torque from 60 to 40 per cent of full load running torque, depending upon the speed. The maximum torque available is approximately 200 per cent of full load running torque.

"Reco" Control Device

To meet the need for an unfailing control device to regulate operations, the timing of which can be predetermined, the "Reco" industrial control has been placed on the market by Reynolds Electric Company, 2657 West Congress St., Chicago, Ill. A few of the uses are for the stopping, starting and reversing of motors, for the automatic operation of signals, elevators, fire pumps, automatic doors, call systems, and danger signals.

The control is motor driven, the motor revolving a cylinder drum which is provided with adjustable



"Reco" Industrial Control Device

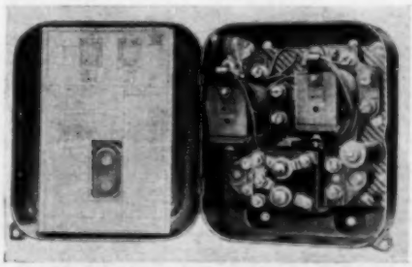
contacts, making a contact with a goose-necked brush as it rotates. The features are complete flexibility, giving any speed of timing desired, easy accessibility, and ease of installation and adjustment. By the variation of the pulley wheel size and the use of various sized contacts, a wide range of predetermined timing action can be secured. The device is suitable for application to machine tools where the stopping and starting points can be predetermined.

Westinghouse "Linestarter" Without Cabinet

In some machinery applications, it is desirable to mount the starter within the machine and in this case, the cabinet is not required. For such services, the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., supplies the unit of the improved "Linestarter" without cabinet. Like the other Linestarters this starter is also equipped with the "Deion" arc quencher and the thermal overload relay. These improved features add to the safety of operation.

The Deion arc quencher provides a high degree of protection from flashovers under severe operating conditions and also increases the life of the contacts. Because the arc is completely restricted within the arc quencher, the overall size of the starter has been decreased without any decrease in safety.

Another added feature is the combined hand and automatic reset thermal overload relay. The automatic reset of this relay relieves the necessity of the operator going to the starter to put the motor back on the line after an overload. This also permits remote mounting with minimum loss of time and greater machine output.



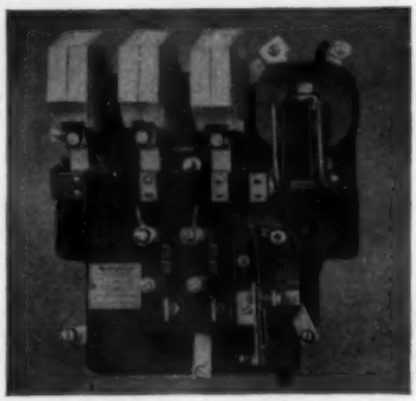
Westinghouse "Linestarter" Without Cabinet

The Linestarter without cabinet may be obtained in three sizes covering a range up to 50 horsepower.

Cutler-Hammer Automatic Across-the-Line Starter for D.C. Motors

An automatic, across-the-line starter, for general application to d.c. motors up to 2 hp., 115 or 230 volts, has been announced by Cutler-Hammer, Inc., 80 12th St., Milwaukee, Wis. Important features incorporated in this design are: small size, low cost, double line break, thermal overload protection, low voltage protection, silver contacts, and completely inclosed structure. Two magnetic contactors, one in each side of the line, connect the motor directly across the line on starting and provide a double line break. The contactors are designed especially for d.c. service. They have renewable silver contacts and a heavy stamped frame.

The thermal overload relays are the same as those used in the company's a.c. across-the-line starters for small motors. They are of the fusible-alloy type and can be adapted to any size motor by simply changing the heater coils. When tripped by an overload, the relays are reset by pushing a button in the cover.



Cutler-Hammer Automatic Across-the-Line Starter for d.c. motors up to 2 horsepower

Each starter is furnished with a push-button master switch providing three-wire control. This master switch can be furnished mounted in the cover of the starter, or it can be arranged for mounting separately. The starter with push-buttons in cover is illustrated. These starters are also made without the thermal overload relays, for applications where overload protection is not required.

REVIEW · OF · RECENT · PATENTS

Relating to the Machinery and Metal Products Industries

Parts and Mechanisms

To Carl W. Weiss, Brooklyn, N. Y., has been assigned patent 1,728,949 on a universal joint having a floating conical rolling body formed with radial teeth, and other co-operating parts.

A tool-holding chuck, comprising a housing, a chuck member therein, having inner and outer sections, and a collar locking member, is the subject of patent 1,726,295, assigned to the Gardner-Denver Company.

The Kearney & Trecker Corporation is assignee of patent 1,726,330 on a lubricating means for machine tools, comprising means for raising lubricant from a sump and delivering it to gearing and other parts at a level above the pump.

To the Rich Tool Co. is assigned patent 1,726,353 on a poppet valve with a head-covering comprising an envelope, having two parts with edges rolled together to form a heat-radiating head.

Conrad Hoerl, of Newark, N. J., has been granted patent 1,726,562 on a centrifugal clutch having a pivoted clutch means for operating two approximately semi-cylindrical shoes.

A device for forming by extrusion internally threaded caps with flanged tops, is the subject of patent 1,726,442, assigned to The Sun Tube Corporation. The device comprises a pair of die-blocks, a loose ring, and a plunger, one end of which is threaded.

To the Landis Tool Co. has been assigned patent 1,726,247 relating to a traversing mechanism for grinding machines, comprising a work carriage, an abrading device carriage, splined pinions engaging with racks, and means for selective operation of the pinions.

The Oilgear Co. is assignee of a

variable speed hydraulic transmission having a casing, a variable displacement pump, a variable torque motor, and connecting means for adjusting simultaneously the pump displacement and motor torque.

A hydraulic power transmission mechanism, having a plurality of pistons, a slip ring, and a counterbalancing weight in novel arrangement, is the subject of patent 1,728,962, granted to Frederick J. Fahle of Toledo, Ohio.

To the American Twist Drill & Tool Co., has been assigned patent 1,729,012 covering a straightening device having a multiple-throw crankshaft, three jaw carrying members reciprocated by said shaft, and independent means for supporting the work.

Patent 1,729,111, assigned to the Imperial Metal Products Co., relates to a steady-rest having an annular bearing, a two-part clamping member rotatable in said bearing, and other co-operating parts.

Patent 1,729,245, assigned to the W. M. Chace Valve Co., covers a bimetallic thermostat element, one metal of which contains carbon, silicon, nickel, and iron, the other carbon, silicon, chromium, nickel, copper, and wrought iron.

A friction clutch, having concentric driving and driven members, a friction device having cam surfaces, and other co-operating parts, is the subject of patent 1,729,376 granted to Joseph G. Fay of Seattle, Washington.

Patent 1,729,343, assigned to the Delco-Remy Corporation, covers a dynamo brush including graphite, water glass, and a non-abrasive moldable binder.

To the Westinghouse Electric & Manufacturing Co. has been assigned patent 1,729,435 on a flexible gear wheel, having center and rim portions engaging segmental spring elements adapted to be forced into conformation with the gear rim under tangential deflection.

Patent 1,729,442, assigned to the Westinghouse Electric & Manufacturing Co., covers a flexible gear having cylindrical spring sockets on the ends of spring elements for engagement between the center portion and rim portion.

A lubricant-retaining joint, comprising a link and a lever with joint members and a pair of resilient members having slots arranged in staggered relation, is the subject of patent 1,729,445, assigned to the Westinghouse Electric & Manufacturing Company.

An abrasive wheel having a plurality of rows of abrasive segments, a freely movable friction member between adjacent segments, and the means for pressing the segments together, is the subject of patent 1,729,585, assigned to the Norton Company.

Patent 1,729,594, relating to a power chuck actuating device, comprising an electric motor, a drive for a rotative member, and clutch means at the end of a spline shaft in said member, has been assigned to the Goss & DeLeeuw Machine Company.

TRADE PUBLICATIONS

BALL BEARINGS. New Departure Manufacturing Co., Bristol, Conn., has published a catalog on its "N-D-Seal" ball bearings for electric motors, small pumps, vacuum cleaners, portable electric or air-driven tools and like equipment. It features the design, construction, and the applications and engineering data pertaining to these bearings. The bulletin contains sixteen 9 x 6-in. pages.

FLEXIBLE COUPLINGS. The Morse Chain Co., Ithaca, N. Y., has published bulletin No. 37 on flexible couplings, showing installations, ratings, dimensions and prices and giving data on how to select a coupling. It also gives a complete list of couplings grouped according to pitch. The catalog contains 23, 11 x 8½-in. pages.

LUBRICATION SYSTEM, CENTRALIZED. Lubrication Devices, Inc., Battle Creek, Mich., has published "A Picture Story of Farval." The booklet contains thirteen pages of illustrations showing the device on various kinds of equipment. The catalog contains fifteen 11 x 8½-in. pages.

MOTORS, SQUIRREL CAGE. The Wagner Electric Corporation, 6400 Plymouth Ave., St. Louis, Mo., has published Bulletin No. 165 covering its line of squirrel-cage motors in seven types. The bulletin is gotten out to explain to motor buyers and users the difference between the various types of squirrel-cage motors and to aid in their selection. The booklet contains 22, 11 x 8½-in. pages.

TUBING, COPPER, BRASS AND ALUMINUM. The Wolverine Tube Co., 1411-1451 Central Ave., Detroit, Mich., has published a folder showing tables of the diameters of seamless copper, brass and aluminum tubing and giving the weights per lineal foot.

VALVES, CONTROL, AIR. The Logansport Machine Co., Logansport, Ind., has printed circular 24-A describing the complete "Logan" line of standard air control valves operated by various means and applicable to machine tools. The catalog is illustrated throughout and each product is thoroughly described. It contains twelve 8½x11-in. pages.

WIRE CLOTH AND WOVEN SCREEN. The Ludlow-Saylor Wire Co., Newstead Ave. and Wabash Railroad, St. Louis, Mo., has published a booklet giving complete reference data on double-crimped wire cloth and woven screens of its manufacture. Hundreds of wire cloth meshes are listed. Illustrations of various equipment are also included. The catalog contains 36, 10½ x 7½-in. pages.

ABNORMALITY IN CASE-CARBURIZED STEELS. The Mining and Metallurgical Advisory Boards, Pittsburgh, Pa., have published Co-operative Bulletin 45 on "Abnormality in Case-Carburized Steels" by C. H. Herty, Jr., B. M. Larsen, and others. Although not conclusive, the research results given offer explanations for some of the puzzling phases of the causes of abnormal structures of steel, their sources in the steel making process, and their connection with the more general problems of the physical chemistry of steel making. A copy of the bulletin may be obtained from the above for $1.

BUREAU OF STANDARDS REPORT. U. S. Department of Commerce, Bureau of Standards, has published Bulletin 102 giving the annual report of the director of the Bureau. The bulletin gives much information on the progress made in the past year in the various studies undertaken by the department. The bulletin may be obtained from the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C., for ten cents.

FATIGUE CRACKS IN CAR AXLES. The University of Illinois, Engineering Experiment Station, Urbana, Ill., has published bulletin No. 197 on "A Study of Fatigue Cracks in Car Axles," which is Part II of a report conducted in co-operation with the Utilities Research Commission. This bulletin deals with the safety of the practice of turning down car axles in which a fatigue crack has developed and then using them for smaller axles or shafts. The bulletin contains 30, 9 x 6-in. pages.

ZINC, ROLLED. The New Jersey Zinc Co., 160 Front St., New York, N. Y., has published a research bulletin which brings together the various facts pertaining to zinc in wrought form, particularly rolled zinc. The bulletin is primarily intended as a reference work, and covers as far as possible all phases of the subject from qualities which govern its use and methods of ordering to a chapter on metallography. The publication contains 54, 9 x 6-in. pages.

NEWS
OF THE WEEK

Key Men of American Business Respond to President's Call

By Paul Wooton
Washington Correspondent, American Machinist

A GIGANTIC stride toward "systematically spreading into industry as a whole the measures which have been taken by some of our leading industries to counteract the effect of the recent panic in the stock market," as the President phrased it, was taken at last Thursday's conference of industry in Washington. Never before in America's industrial history has such a complete cross-section of the nation's business gathered together for conference. It was undoubtedly the greatest symposium of business talent ever assembled in one room.

In his address, President Hoover did not attempt to hide the fact that there is unemployment and that there has been reduction in the demand for certain types of goods, but his plea was to squeeze the emotion out of the situation, because emotions, "if they had been allowed to run their course would, by feeding on themselves, create difficulties."

The purpose of the conference, the President pointed out, was to organize new construction and maintenance work to take up any slack in employment which may arise in other activities. He called attention to the fact that business men and economists are agreed that the acceleration of these activities in time of need makes "a great balance wheel of stability." He made the statement without qualification that "temporary speeding up to absorb idle labor brings great subsequent benefits and no liabilities." He emphasized the fact that nearly one-fourth of American wage earners are employed, directly and indirectly, in construction and in the industries engaged in the preparation and transportation of its raw materials. Another point made by the President, to which significance is attached, is his assertion that there is no advocacy of production of consumable goods beyond the daily demand. That, he said, would only stir up future difficulty.

No more important point, in the opinion of those assembled, was made by the President than that with reference to export trade, "We gain in prosperity by a prosperous world, not by displacing others." This thought was expanded by Dr. Julius Klein, the assistant secretary of commerce, in the course of his remarkable address, when he said:

"Above all things, our export effort should not be casual or take on the remotest semblance to a dumping campaign. Nearly every desirable market abroad is well protected against such procedure by legislation which would immediately be brought to bear and would discredit not only the individual traders involved but all American export in the given region.

"One of the major elements of strength in our economic position is the fourteen or more billions of dollars which our citizens have invested abroad. Just as England laid the foundations of her far-flung export activities by huge foreign investments, so we today can assure the maintenance and further development of our foreign trade through the legitimate, constructive acceleration of these holdings. Many of our investments in foreign public utilities and industries are reflected in our exports of material and equipment. The indirect effect in building up exports is even greater."

The popularity of the President with the delegates was manifested by the prolonged applause when he appeared on the platform. The enthusiasm displayed partook of the political convention rather than a meeting of business men.

Dr. Klein Scores

Dr. Klein also scored a personal triumph. His speech was one of the features of the day. He got off to a flying start by stating, subtly, after having listened to organization formalities, that "the steam-roller industry" has not been inpaired in the slightest. "It now is time for business men to get out of the huddle and carry the ball," he said. He told how the field of business had been illuminated and that the chance of panic under present conditions is immeasurably less than in the old days of obscurity and uncertainty. The universal penetration of the radio makes it possible for the nation to have a play-by-play report in such a situation. He called attention to the host of new facilities which dispel the dark shadows where malevolent growths of doubt, of suspicion, and of fear previously have thrived. The air mail, he declared, makes statistics available in the farthest corners of the land while they are still timely. Telephone mileage has jumped from 11,600,000 to 62,200,000. Business is infinitely closer knit than at any other time in history. In this union there is strength. Enlightened collaboration is an indispensable element in economic stability.

Continuing, Dr. Klein emphasized the improved quality and the increased influence of the business press. "Today the keen acumen of trade editors and their expert staffs," he asserted, "has made the sequestration of any important economic facts difficult, if not impossible."

"There are at the moment," Secretary Lamont said in his talk to the conference, "more equipment orders on hand and in prospect than at any time in the past several years. These orders will help materially the steel, locomotive, car building, and allied industries. The important thing is to keep up employment and wages, which spell buying power. Not many years ago, at the first sign of slackening business the immediate thought was to lay off men and to cut wages. I have heard of but one instance in these recent weeks in which such action was proposed. Even in that case the notices which had been posted in the plants were withdrawn after one of the recent White House conferences." Then came this significant statement from the Commerce Secretary: "We have learned that, when necessary, it is better to reduce hours than wage rates. If worse comes to worst, it is advisable to alternate men by the week, giving some income to as many as possible."

Julius H. Barnes, chairman of the board of the U. S. Chamber of Commerce, saw in the conference an epoch-making event in the evolution of modern industry. "Public confidence is industry's greatest asset," he said, "an asset attained in recent years by the development of established ethics and standards and in the formulation of fair business practices." He told those in the assemblage that there is a very encouraging side of the industrial picture. A revival of the shipbuilding industry is under way. Oil has set its house in order. Agriculture is being restored to a fair relationship with other industry. Current commercial news records unexampled instances of extra dividends, as well as an unprecedented number of initial dividends. Mr. Barnes also called attention to the fact that modernization of old buildings offered a most profitable field even in those communities where residential and apartment building have reached an apparent saturation point.

Team-play of Business

President Butterworth of the National Chamber spoke of the war service of industry as an example that business has a fine capacity for team play. Out of

that era, he said, grew widespread industrial co-operation through trade associations, encouraged as it was by the leadership which came to the Department of Commerce in the post-war period. The man who helped so greatly to make trade associations serve the public so well is now the American Commander-in-chief. While others paused, he recalled, President Hoover acted to restore confidence.

A deep impression was made upon the conference by the statement of James A. Farrell, President of the United States Steel Corporation and chairman of the board of the American Iron and Steel Institute that this is time for co-co-operation between government and business. He expressed the opinion that business likes this idea of co-operation as well as the government. Regarding the steel industry's program in 1930, Mr. Farrell stated that there would be no changes in either wages or prices. "Now is the time," he said, "for the steel industry to modernize existing plants and make repairs." Authorized expenditures for this purpose total $500,000,000.

Frank H. Smith, president of the Portland Cement Association, stated that shipments of cement in 1929 will run about 3 per cent less than those in 1928, and that, prior to the recent Hoover conferences, it was expected that shipments in 1930 would be anywhere from 5 per cent to 10 per cent less than during the current year. Since then, he said, the industry has gained more confidence and now expects that as a result of large appropriations for road building and public works, and increased construction and maintenance work planned in industry, the expected slump will be forestalled.

Agriculture on Upgrade

Agriculture was well represented at the conference. Louis J. Tabor, master of the National Grange, remarked that this is evidence of the new relationship which has been established between industry and agriculture. While yield and market conditions do not justify an over-optimistic statement concerning agriculture, Mr. Tabor stated that the measures inaugurated this year will be very helpful in improving the present situation. Manufacturing industry and trade will benefit, he said, in direct proportion to the increase in the farmers' purchasing power, which is expected to materialize with the working out of the Federal Farm Board's program.

There are problems but no weaknesses in the banking structure, John G. Lonsdale, president of the American Bankers Association, told the conference. Ample bank credit is available, he said, for financing industry and trade, but he added a word of caution against arousing too much expectation of cheap money. The banks are prepared for constructive expansion and as long as business is reasonably active and bank credit moves through its normal cycle, Mr. Londsdale said that there is nothing to fear.

Trowbridge Calloway, president of the Investment Bankers Association, stated that investors are giving more attention to security and dividend rates than to market appreciation. An increased demand for building mortgage securities was reported by Hiram S. Cody, representing the Mortgage Bankers Association. More interest has been evinced in home ownership as a result, said Mr. Cody, of the bitter experience of amateur speculators.

Alvin Macauley, president of the National Automobile Chamber of Commer, advised the conference that the industry, which is most generally referred to as that principally affected by recession, is in a wholesome and healthful condition. He expressed confidence that the automobile industry will remain true to the tradition that it is always among the first to come back and to start climbing to new prosperity records. The replacement demand, plus exports, will account, he said, for a production of 3,750,000 cars and trucks next year, which amount to 75 per cent of a normal year's business. To this must be added new buyers, new car families, and a rapidly increasing truck and bus business that should bring the total to 5,000,000. The present recession in business has been described as the test of instalment selling. Mr. Macauley stated that the selling of automobiles on time payments has shown itself to be a constructive practice and a real ally to the prosperity of the industry. He expressed the opinion that it can be expected to continue its work of keeping people employed and encouraging a healthy consumption of product. He reported that cancellations and failures to meet payments have been so small as to be almost negligible.

Experience appears to have demonstrated that the ship-building industry prospers when other industries languish, said Homer L. Ferguson, president of the Newport News Shipbuilding and Drydock Co. There is four times as much merchant shipping work under way now as a year ago, but the industry can handle 50 per cent more next year, Mr. Ferguson told the conference. The Jones-White Act was described by Mr. Ferguson as the first constructive legislation for placing an American merchant marine on the seas. He declared that the criterion under that law should be, "What new ships can be profitably employed rather than what new ships we would like to have flying the American flag and carrying the mails." As control of new ship building rests largely in the hands of the government, Mr. Ferguson expressed the hope that the program formulated would be reasonable. He explained that the ship-building industry would prefer a steady procession of new orders spread over a period of years to a sudden rush of orders that would overtax its capacity.

Declaring that the railroads do not believe that there is anything in the existing situation that would warrant them to reduce or abandon any part of their capital program, R. H. Aishton, chairman of the executive committee of the Association of Railway Executives, informed the conference that their 1930 program calls for an expenditure of $1,050,000,000, of which $370,000,000 has been budgeted for equipment and $680,000,000 for roadway and structures.

The 1930 program of the public utilities presented to the conference by Matthew S. Sloan, president of the National Electric Light Association, calls for the expenditure of $1,400,000,000 for new construction, an increase of $110,000,000 over that of 1929, and $410,000,000 for maintenance. The public utilities are healthy, said Mr. Sloan. He reported that, according to reports from company executives, the number of investors in electric utility companies has increased largely in the past two months.

A plea for prompt action on the tariff bill was also sounded by Otto H. Falk, president of the Allis-Chalmers Manufacturing Co., Milwaukee, who appeared as the representative of the machinery industry. He explained that because of the relation between machinery purchases and production levels, the industry is particularly sensitive to general business conditions. Despite the recent break in stocks, however, little adverse effects have been felt by the machine industry. He expressed the opinion that present production schedules will be maintained during 1930 and that there will be no decrease in the present employment. Representatives of other machinery producers brought out the importance of increasing capital expenditures to keep industrial equipment up to date and to provide against obsolesence. Much can be done toward improving equipment.

Ready Cash On Hand

The life insurance companies and other insurance organizations will have about $800,000,000 to invest in construction enterprises during the coming months of the new year, it was stated by Frederick H. Ecker, president of the Metropolitan Life Insurance Company.

George D. Olds, Jr., vice-president, Hills Brothers Co., and president of the Associated Grocery Manufacturers of America, endorsed President Hoover's suggestion of "work," for, he said, "The harder men work the more they eat."

Farm implement equipment was not materially affected by the market deflation, A. E. McKinstry, vice-president of the International Harvester Co., and president of the National Association of Farm Equipment Manufacturers, declared. The farmer took his deflation in 1920, according to Mr. McKinstry, and has been steadily improving since then.

A group of 72 key men was selected from the body of the conference to coordinate and follow up the several programs of activity outlined for 1930 by the spokesman for the various industries. This committee, as emphasized by President Hoover, is in no sense a permanent supereconomic council. Once it has shown the way of sound business to individual businesses, it is to be disbanded.

Henry Ford's Visit to the Westinghouse Museum

In the picture, left to right are: T. P. Gaylord, vice-president; J. S. Tritle, vice-president; Henry Ford; W. S. Merrick, president; W. S. Rugg, vice-president

November's Significant Developments Occur in Many Fields

SIGNIFICANT in the events of the month, tangible evidence of the increasing desire of engineers to cooperate in the advancement of knowledge, was the gift on Nov. 19 of a complete collection of old-time electrical devices and machinery to Henry Ford for his museum at Dearborn. It had taken the Westinghouse Electric & Manufacturing Co., the donor, much time and money to collect 600 examples of early development, and yet the entire collection was offered, gratis, to a man who is trying—in spite of his lack of belief in history—to gather together examples of scientific progress from all over the country. The exhibit was presented to Mr. Ford by F. A. Merrick, president of Westinghouse, and W. S. Rugg, vice-president. It is interesting to note in this connection that the essential elements of all present-day electrical machines were developed in the first period of 6 years, from 1886 to 1892. These include generators, motors, meters, converters, switchboards, and transformers.

Progress in design during the month has not been predominantly in any one field. Despite the fact that airplane and radio developments have held the spotlight for several months past, other lines of endeavor have been making just as great advances. Examples of radical changes in design may be taken from any field. For example, in the electrical equipment field, there are three new types of washers, several unusual sun lamps, griddles, heaters, an unusual motion-picture camera and projector, and a combination drink mixer and orange squeezer. These are simple things, every one of them, but they all present problems in design and they have never been made in exactly their present fashion before. And in the radio field, in addition to the inevitable developments in screen-grid hook-ups and similar advances, there is a new fifteen-record phonograph to be combined with a radio, using a single amplifying unit. Further, there is a radio display truck adaptable for use in other lines as well. It is fender-wide ordinarily, but may be widened to give a show room 10 ft. wide, 7 ft. high, and as long as the body. There are dozens of other products that will give ideas to designers, but these will serve as examples.

In the aviation field, further developments in the gyroscope for driving planes, a new reversible and adjustable pitch propeller, further refined by its inventor, A. K. McCloud, a 625-lb. "vest pocket" plane, and the completion of the world's largest land plane, the Junkers "Flying Wing," are perhaps outstanding. The Junkers plane has its four motors and cabin for 100 passengers built into the wing, which has a spread of 147 ft. The successful flight of Commander Byrd and his companions to the South Pole in a Ford tri-motor plane is also an indication of success in designing to meet very difficult conditions. The plane is a conventional type, but was built especially for the expedition, almost entirely of Duralumin. Several German planes with little or no tail have made successful flights during the past month. Among them is a rocket type.

The metals market during the month as a result of the uncertainty of the stock market, was slow, most buying being for immediate needs. It is probable that, until after Jan. 1, ultimate consumers will be slow in placing orders, but buying is expected to improve in the latter half of January. Tin, lead, and zinc declined most during the month. Copper and aluminum remained unchanged and antimony made a slight gain. Copper is selling at 18 cents a pound delivered, tin at 40.5—a drop of two full cents, and lead at 6.29, a drop of 0.51 cents. Antimony is now seling at 8.52, aluminum at 23.9 as before, and zinc at 6.23, a drop of 0.51 cents.

* * * *

Asserts Engineers Dominate America In Talk at A.S.M.E. Meeting

L. W. Wallace describes rapid rise of scientific men in politics and business as well as technical fields

DECLARING that a survey has shown that engineers dominate American life, Lawrence W. Wallace, executive secretary of the American Engineering Council, in his address, "Engineers in American Life," on Dec. 3, at the annual convention of the A.S.M.E., gave a comparison based on a study of engineers and their contemporaries in "Who's Who." Edward Eyre Hunt, secretary of President Hoover's committee on recent economic changes, stated that fundamental business conditions are stronger at present than they were at the beginning of last year, during his talk which preceded Mr. Wallace's. Following these talks, the report of the tellers of the election of officers was given, and president-elect Charles Piez was introduced.

The annual report of the council was given on the preceding evening by C. E. Davies. Awards were presented to Arthur M. Wahl, East Pittsburgh, Pa., and Frank V. Bistrow and William W. White, Seattle, Wash. The nominating committee for 1930-31 was announced, as well as the resolutions in tribute to Worcester Reed Warner, sixteenth president of the society.

Two other papers presented during the technical sessions of the meeting are abstracted in this week's issue, and further papers will appear in abstracted form next week.

"Recent Developments in Aircraft Engines," by John H. Giesse, records progress during the year in engine design. Some of the problems encountered, and the methods of overcoming them, are described in the paper.

D. S. Jacobus presented a paper on "Working Stresses for Steel at High Temperatures," which endeavors to dispel the existing apprehension regarding the use of steel at high temperatures, and compares the methods now in use for determining the creep of steel.

A paper "On the Mechanics of the Plastic State of Metals" by A. Nadai, is a study of the mechanical conditions under which plastic flow in metals occurs. Rules relative to the stresses and the deformation when the stresses reach the limit of plasticity are discussed.

Other papers of interest to designers and engineers are: "Elastic and Inelastic Behavior in Spring Materials," "Natural Frequency of Gears," and "The State of Stress in Full Heads of Pressure Vessels." Preprints of these papers may be obtained by addressing Calvin W. Rice, Secretary, the A.S.M.E., 29 West Thirty-Ninth St., New York.

BUSINESS · BAROMETER

Public and semi-public expenditures during 1930 promise to be large, and business is said to be on an even keel

By THEODORE H. PRICE
Editor, Commerce and Finance, New York

PRESIDENT HOOVER is entitled to great credit for his promptitude and prescience in checking the business depression that threatened to spread over the country because the stock market had declined. Once again he has shown that "there is nothing good or bad but thinking makes it so," and that both optimism and pessimism are the result of psychological conditions.

Under the leadership of Mr. Hoover the captains of American business and industry gathered in Washington and pledged themselves to the constructive expenditure of many billions of dollars. In so far as they are in power to do so, the governors of various states have pledged themselves to pursue a similar policy, and bills which provide for radical increases in the expenditures of the Federal Government for public works and improvement have already been introduced into Congress. To the program as thus outlined and adopted, President Hoover gives approval in his message. Therefore, public as well as semi-public expenditures during the year 1930 promise to be large, for it is not usually difficult to get executives to spend money that is raised by taxation or the sale of new securities.

Facing these conditions, it is natural to ask what the result will be. The economic situation is much like the one created by the war except that no destruction of property is involved. That some change in the purchasing power of money will be brought about by the large expenditures that are in prospect seems to be almost certain, and it would appear to be equally certain that the value of a gold dollar as measured by merchandise will be reduced during the next twelve months. Put in ordinary language, this means that the price of staple commodities will rise, even though the market for stocks and bonds may remain stationary.

The experience of the past justifies this prediction, and recent occurrences have shown that precedents are not to be spurned even though they may be ancient. Assuming that this brief prognosis of the situation is correct, it is in order to ask what will be the effect upon business. To this question, the logical answer seems to be higher-priced commodities, for commodities always advance when the value of money declines. Just now the probability of such a change in the fundamental relationship between money and merchandise seems to be imminent.

From this page the reader will get a quick picture of current business and industry. The boxed material below is a summary of the letters from regional correspondents of the American Machinist, published in full on the opposite page.

LITTLE change has occurred in machinery and machine-tool markets in the country during the past week. The consistent increase in the Canadian and other export markets is perhaps outstanding, with the greater interest of the railroads and construction machinery companies a close second. Prices are not expected to change for some time to come. Deliveries are slowly improving, and are expected to continue doing so as the year comes to a close. The used-tool market is comparatively slow, better deliveries on new tools having contributed to its slowness. Demand is holding steady, but in many cases, inquiries are showing considerable improvement.

OPTIMISM is general in the market, and considerably better business is expected after the first of the year when new budgets will be out. The New York market is as good as usual at this time of the year, a wide variety of industries buying. Cincinnati manufacturers have made a gain in sales so far this year, and railroad inquiries and purchases are interesting dealers and manufacturers. The Indianapolis market has struck a slight seasonal lull, though automotive buyers are again entering the field. New England business is better than fair, with railroads holding the spotlight. Canadian railways are showing interest. Chicago business is expected to remain unchanged until the first of the year, but inquiries are already increasing. The Detroit market is a little better, with some automotive manufacturers buying equipment for new models.

Meanwhile it may be said that the American ship of business is again on an even keel. Those who lost heavily in the recent decline in the stock market are still pessimistic, but most of our population has recovered its normal optimism, and while the expenditure for luxuries this Christmas won't be as large as it was a year ago, the retailers do not seem to be seriously disturbed over the outlook. The chain stores and most department stores as well sold more goods in November than in the same month a year ago, and where decreases occurred they are frequently ascribed to unseasonably warm weather.

It is estimated that from ten to twenty million people were speculatively interested in the stock boom, but of these at least one-half would normally be stockholders, and if the stock market had not taken the money that the other half lost they would probably have spent it in some other way. The important thing to remember is that there has been no real loss or destruction of property, and that the wealth of America is just as great as ever.

The commodity markets have been quiescent, but they have all shown an undercurrent of strength. Silk is a little better. Coffee is low, but its cheapness will be somewhat doubtful until it is proven that the large Brazilian stocks can be disposed of without a further depression in the market. Sugar appears to be very near the irreducible minimum, though the statistical position is obviously weak. The same thing may be said of rubber. Steel and copper are steady, although a slight reduction in the demand is reported by the trade authorities.

As a result of the decline in the money market, an increase in the new building under consideration is reported. Iron and steel mill activity is still declining, and some textile manufacturers have curtailed operations. Automobile production is the lowest in two years and the industry will begin the new year cautiously. But Ford has an ambitious production program and a prominent executive who has frequently been right believes that by March the industry will be selling as many cars as in 1928.

Distributive trade in what may be called the necessaries, or semi-luxuries, is fully up to an average, and if the lamentations of those who sell jewelry, furs, cosmetics, and other articles deluxe could be silenced, the tone of the markets would be pitched in a major key, and sound much more cheerful than it does to those who listen to the hard-luck stories of New York speculators and inexperienced stock traders.

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THE INDUSTRIAL REVIEW

Weekly progress of the machinery and machine-tool business

THE following reports, gathered from the various machinery and machine-tool centers of the country, indicate the trend of business in these industries and what may be expected from the future:

CANADA

As a result of the general improvement in industrial conditions, the market for machinery and machine tools in Canada is increasing steadily. The outlook appears bright for all branches of the metal-working industry. The railways are coming into the market for new equipment and rolling stock. The Canadian National Railways have called for tenders for 3,000 box cars, 200 refrigerator cars, 15 express refrigerator cars, and 25 tank cars. It has been estimated that the equipment needs of the two major railroads for 1930 will approximate $22,000,000. The automotive industry shows signs of improvement for the first time since May. Production of automobiles in October at 14,523 cars was a gain of 5 per cent over the total of 13,817 cars made in September.

DETROIT

Although the general business atmosphere has improved here within the past two weeks, dealers are receiving few orders for machinery or machine tools and there is little indication that the situation will improve during the remainder of this year. The fact that some of the automobile plants have resumed operations gives some basis for optimism, but this is unsupported either by orders or by inquiries.

In general, the month of December is considerably better than November, which was by far the poorest of the year in Detroit and Michigan. Sales for November in many lines dropped to a level that has not been reached for several years here and an occasional dealer reports that conditions have not materially improved. One dealer has already received a large order for machinery to be used in the manufacture of a new eight-cylinder motor. Several others are working on deals of some importance but the prevailing belief is that few large orders will be given in 1929.

NEW YORK

Considerable optimism is being expressed in the machinery and machine-tool market in New York, partially because of President Hoover's conferences, and partially because of the steadying of the stock market during the past ten days. Business is considered as good as usual at this time of the year, and inquiries are also picking up slightly. Purchases come from a wide variety of fields, but most orders are for single items. The Bethlehem Steel Co., purchased 5 radial drills at a reported cost of $50,000, however, and there is an increasing amount of railroad buying. The New York Central and the N.Y. N.H. & H. are most active. Ingersoll-Rand is inquiring about lathes. Printing press, conveyor, truck, and aircraft manufacturers are also in the market.

In many firms, November is expected to compare favorably with October and preceding months and in few has a slump of any proportion occurred. Deliveries are getting better gradually on most lines. Prices are expected to remain where they are for some time to come. As usual at times when business is expected to be slow, a number of buyers are attempting to place orders under conditions which would not have been accepted previously—and are meeting with very little success.

The used-tool market is slow, partially because of better deliveries on new machines. The export market is getting better steadily, and is expected to be an important part of the market in 1930. One large dealer in New York reports no cancellations whatsoever; all companies he represents are sold ahead for several months. The reports of other dealers are similar in tone. The feeling is general that the first of the year will bring new budgets, new business, and even increased good feeling.

CHICAGO

While the situation in the machine-tool market is practically featureless at this time, there are well-defined indications that from now on the trend of business will be upward. This is the belief expressed by manufacturers' representatives and dealers, the belief being based on the surprisingly good volume of inquiries received in each mail. It is not thought, however, that action on the most important of these will be taken until January is well advanced, general industry again approaches normal production, and the country has recovered from the setback experienced as a result of the stock market slump. Railroad inquiries are expected in satisfactory volume just as soon as the 1930 budgets are passed on and expenditures for shop equipment authorized. Agricultural implement manufacturers also are said to be preparing for increased activities in their plants, and are getting into shape for largely increased production. Builders of road construction machinery, encouraged by the large appropriations for new highways, now being gone over by the legislatures of several midwestern states, will, should these appropriations be voted, enter the market as liberal buyers of needed shop equipment. Demand for used tools is reported as fairly good. Deliveries are said to be better than for several months.

NEW ENGLAND

Conservatism, a New England characteristic, is apparent in all transactions and industrial operations here. Any change in the market from week to week has been slight, however, and some lines hold up remarkably well. Inquiries are also in better than fair volume, and there is an indication of better deliveries by from one to two weeks.

Anticipated buying schedules are encouraging in most lines of industry. Seasonal curtailment has been noted in manufactories supplying the automotive, household appliance, and radio industries.

The outlook at this time while not as radiantly rosy as a year ago, is very promising. In addition to the N.Y., N.H., & H. Railroad Co., the Vermont Central and the Maine Central railroads plan improvement expenditures including rolling stock. The latter road will spend $1,000,000 for a new coal-handling plant for which conveying equipment is required. Conveying machinery is also selling well to a number of industries in this section. Power equipment is selling strongly with a very favorable market for small motors. Machinery and machine tools for builders of power equipment and their co-ordinating industries is anticipated by the industry as a strong future market factor.

INDIANAPOLIS

The machine-tool and machinery business here seems to have struck a slight lull that is expected to last until the first of the year. This area is beginning to feel the usual pre-holiday period of slowness, though business is being done and it is altogether likely December business will exceed that of last year considerably.

A slight increase is seen in the demand for special machinery and machine tools from the automobile trade, which is working on new models. But, until the factories actually get into quantity production on these models, the volume for the machinery dealers will be somewhat restricted. Demand is beginning to be felt from the farm implement factories which are preparing for a good spring.

The demand for special machinery from the radio industry, both unit and cabinet manufacturers, continues unabated, and this year will see another record for business done with these factories in this area. With the coming of sub-zero weather, the railroad shops in Indiana are increasing their buying of tools and equipment for immediate requirements.

Inquiries from all sources are rather active in spite of the lull in buying. They are coming from a wide variety of sources, also, which is very encouraging to the manufacturers. Dealers in road construction machinery especially are expecting business to open with a rush during the first of the year. Contracts for roads are already being let, the work to start as soon as weather permits, and the mileage is expected to be far greater than in any previous year.

CINCINNATI

A decided spirit of optimism prevails in the machine-tool trade of the Cincinnati district. Regardless of any decrease in the demand that may have been caused by the recent stock market slump, the manufacturers have made a gain in sales so far this year, in comparison to the same portion of the previous year. Once more the business curve is taking an upward course, and sales are climbing back to former good levels. Many manufacturers regard it as safe to predict that orders booked and business coming in from day to day will keep production at a good level for an indefinite period.

Selling agents report that business is holding up well, with a demand in local and adjacent territory that may be classified as better than fair. This year, this branch of the trade has made a gain up to this time and the outlook is regarded as favorable for further increases in coming months.

Among the week's sales was one of six large boring mills to the Bethlehem Steel Company. Several single tools were sold to different railroads and several small exports shipments were made to Russia. The greater part of the week's business was made up of sales of single tools to miscellaneous users, scattered over all sections of the country, and whose requirements were well diversified.

Included in the week's inquiries were several small lists of requirements from railroads. General inquiries flowed in freely from all sections of the country, the great majority of these being from miscellaneous small users, whose requirements were single tools. Several inquiries were received from abroad, most of them being from Russia, but in no case were the requirements large.

Power Show Held As Engineers Meet

New inventions, new power machines, unusual machinery designed for special uses, precision instruments, new metals, important chemicals, and similar power developments featured the Power Exhibition which was held in the Grand Central Palace, New York City, during the past week. The show was held at the same time as the annual convention of the A.S.M.E. and a portion of the program of the meeting of the engineering society was devoted to the show. A record-breaking number of people attended the exhibition, among them army and navy engineers and university and college students from all over the country. Approximately 500 exhibitors occupied the 130,000 sq.ft. of floor space in the palace and the range of material exhibited is unusual.

* * *

Engineer to Describe Conditions in Russia

Leon Moisseiss, consulting engineer of the Amtorg Trading Corporation, New York City, will give a discussion entitled "Impressions in Reconstruction in the U.S.S.R." on Tuesday evening, December 17, at the Engineering Auditorium, 29 West 39th Street, New York City. Mr. Moisseiss is recently returned from a trip to Russia and made an extended inspection of the various manufacturing and engineering projects now under way there.

* * *

A.S.M.E. Offers Standard For Drawing Bolts

A proposed standard conventional method for representing bolt heads, nuts, and screw threads which was recently developed by subcommittee No. 5 on line work of the sectional committee on the standardization of drawings and drafting room practice of the A.S.M.E. is now being issued to industry for critical review and comment. The method attempts to unify present industrial practice and forms a supplement to the proposed American recommended practice on line work, which was distributed for criticism and comment in December, 1928. Copies of the proposed standard may be obtained by addressing C. B. LePage, Assistant Secretary, the A.S.M.E., 29 West 39th St., New York.

* * *

Power Transmission Association Plans Future

Paramount in the annual meeting of the Power Transmission Association at the Hotel Commodore, New York City, on Dec. 4, was the decision to seek outside expert advice immediately concerning future activities. W. H. Fisher, president of the association and secretary of T. B. Wood & Sons, presided. The secretary reported a 12.8 per cent increase in business during 1929 as compared with a 12.5 decrease during 1928. Following luncheon, a special executive committee went into an all-afternoon conference with executives of the McGraw-Hill Publishing Co., at their offices.

Business Items

Loughead Bros. Aircraft Corporation Ltd., has been organized in Los Angeles, Calif., by Allan Loughead, formerly with the Lockheed Aircraft Co., and Malcolm Loughead, inventor of the Lockheed hydraulic brake system. Associated with the Loughead brothers are Ray Acre and Edward F. Andrews, aviation engineers. Development work is now being conducted in secret in a small plant at Glendale, California.

The Helmar Hydraulic Jack Co., Sherman, N. Y., is to establish a plant in Hull, Quebec, for the manufacture of automobile accessories. The company has purchased the factory formerly occupied by the Hull Knitting Co., and repair work has started preparatory to manufacturing at an early date. Extensions to the plant are planned for next spring.

The Milwaukee Die Casting Co., 291 Fourth St., Milwaukee, has purchased four acres of land north of the city for future building purposes but has not made definite plans for the structure or equipment. Henry F. Schroeder, vice-president, is in charge.

The J. D. Adams Manufacturing Co., producers of road building equipment, have purchased a plant occupying an 8-acre site in Paris, Ont. The plant will be operated by a Canadian subsidiary to be known as J. D. Adams (Canada) Limited.

A company is now being formed in Los Angeles under the direction of C. M. Fuller, president of the Richfield Oil Co., to be known as the Airplanes Appliance Co., which will take over the manufacture of the reversible and variable pitch propellor perfected by A. K. McLeod and will manufacture the Hodges straight-line electric starter invented by V. C. Hodges. C. M. Fuller is president, and A. K. McLeod is vice-president and general manager.

The Falk Corporation, Milwaukee, will market its line of flexible couplings through distributors of mill machinery and supplies in the future, instead of through branch sales offices.

Personals

Dean Dexter S. Kimball of the College of Engineering, Cornell University, has been appointed acting president to take the place of President Farrand, who will be abroad for the next two months. Dean Kimball is a director of the McGraw-Hill Publishing Co., publisher of *American Machinist.*

Lieut. R. F. Barnaby, (CC) U.S.N., is now head of the specifications section of the Bureau of Aeronautics, Navy Department. He was formerly assistant general inspector of naval aircraft, central district, Wright Field, Dayton, Ohio.

John L. Harkness has been advanced from the position of assistant production manager of the Sikorsky Manufacturing Corporation, Bridgeport, Conn., to executive engineer.

G. W. Blackinton, formerly factory manager for the Continental Motors Corporation, Detroit, has returned to the Sullivan Machinery Co., Chicago, of which he was chief engineer several years ago.

Nelson R. Hass has founded the Hass Engineering Laboratory, Dayton, Ohio, and is engaged in research and engineering work. He was formerly chief engineer of the Grolan Manufacturing Co. of that city.

A. E. Becker has assumed charge of the fuel and lubrication section of the research laboratories of the Standard Oil Development Co., Elizabeth, N. J. He was formerly in charge of lubrication laboratories.

Charles Healy Day, formerly vice-president and chief engineer of the Gates-Day Aircraft Corporation, Paterson, N. J., was recently appointed vice-president of the New Standard Aircraft Corporation of that city.

Samuel D. Heron, power-plant engineer of the material division of the U. S. Army air corps, Wright Field, Dayton, Ohio, has been awarded the Manly medal for achievement in aeronautical engineering for 1928. The medal is bestowed annually upon the person considered to have made the most important contribution during the year to aeronautical engine development.

H. J. Hassler, assistant to H. S. Jacoby, chief engineer of the H. K. Ferguson Co., Cleveland, was recently placed in charge of planning co-ordination and management of all layout and engineering work.

William E. Bihl has resigned as vice-president and chief engineer of the Iron Mountain Co., Chicago, to become chief engineer and works manager of the Zerozone Corporation, Chicago.

Frederick A. Brooks has been appointed chief engineer of the Apache Motor Corporation, Van Nuys, Calif. He was until lately associated with the Metropolitan Development Syndicate, Hollywood, California.

Donald J. Bullock, formerly research engineer in the A-C Spark Plug Co., Flint, Mich., has accepted a position with Gazley & Lasha, consulting engineers, Washington.

Capt. T. E. Tillinghast, formerly a member of the United States Air Service, has become executive engineer

of the Pratt & Whitney Aircraft Co., Hartford, Conn., a division of the United Aircraft & Transport Corporation. Captain Tillinghast joined the air service in 1917, just after receiving the degree of Bachelor of Science from the Rhode Island State College. In 1919 he became an aeronautical mechanical engineer in the engineering division of the air service at McCook field, and

the following year was given the rank of captain assigned to the power-plant section to engage in the design, construction, and testing of airplane engines.

JAMES A. MEACHAM has been appointed engineer in charge of inspection and research by Harold K. Ferguson, president of the H. K. Ferguson Co., Cleveland. Mr. Meacham has been specification engineer, spending a part of his time on research.

ADIEL Y. DODGE, who until recently was president of the A. Y. Dodge Co., South Bend, Ind., has joined the Bendix Aviation Corporation of that city as consulting engineer.

A. G. GEISTERT has been transferred from the Chevrolet Motor Co., Detroit, to the plant of Adam Opel, A.G., Russelheim-on-Mein, Germany. He is assistant chief engineer.

JOHN MCGEORGE, formerly a consulting engineer in Los Angeles, has established headquarters at Cleveland where he will become identified with Ernest McGeorge, Inc., a firm of engineers.

NEIL E. BROOKS is now chief draftsman in charge of industrial work for the Continental Motors Corporation, Detroit. He was formerly assistant to the industrial engineer.

HUGO H. GUSTAFSON, formerly in charge of engineering work for the Harvey Motor Truck Works, Harvey, Ill., has joined the Acme Steel Co., Chicago, as machine designer.

L. F. MERRILL, for eight years connected with eastern aviation interests, has been appointed chief engineer for the Axelson Aircraft Engine Co., Los Angeles, California.

SEZO S. HATASHITA, formerly designing engineer with the Reo Motor Car Co., Lansing, Mich., has been promoted to the post of experimental engineer.

WALLACE F. OLIVER has been made chief engineer of the Hydraulic Brake Co., Detroit. His previous post was assistant chief engineer.

ISAAC CHAR, formerly gas engine designer with the Autocar Co., Ardmore, Pa., has become a draftsman with the Westinghouse Electric & Manufacturing Co., Lester, Pennsylvania.

FERDINAND A. BOWER, formerly assistant chief engineer of the Buick Motor Co., Flint, Mich., has been promoted to chief engineer.

CHARLES L. BURNS, formerly engineer and assistant to the factory manager of the Pratt & Whitney Aircraft Co., Hartford, Conn., has been appointed assistant to the vice-president.

C. J. BRUKNER, formerly president and general manager of the Advance Aircraft Co., Troy, Ohio, is now president of the Waco Aircraft Co., Troy.

EDWIN GAMBLE has been appointed general manager of the Borg & Beck Co., Chicago. He was formerly chief engineer.

L. S. KEILHOLTZ, formerly chief engineer of the Frigidaire Corporation, Dayton, Ohio, has been made technical assistant to the president.

ALBAN F. CARESON, former assistant body engineer with the Pierce-Arrow Motor Car Co., Buffalo, has been promoted to the post of chief draftsman.

HARRY R. NELSON has been appointed mechanical engineer for the Tool Equipment Sales Co., 18 S. Clinton St., Chicago.

RICHARD M. MOCK, formerly aeronautic engineer with the Bellanca Aircraft Corporation, New Castle, Del., has been appointed superviser of design and construction of airplanes for the American market by the Ernst Heinkel Flugzeugwerke, Warnemunde, Germany.

Obituaries

JOHN A. STEVENS, formerly standardization engineer for the U. S. Shipping Board, died on Nov. 18 at his home in Lowell, Mass. He was 61 years old, and was formerly chairman of the committee appointed by the A.S.M.E. for the purpose of preparing the standard boiler code. He served on this commission for 20 years.

JOHN FRENCH GOLDING, 82, died on Nov. 29 at his home in Philadelphia, Pa. He was the inventor of a widely used process for expanding metal, and had been awarded the John Scott medal for his inventions in 1898.

DONALD MCKAIG, 42, owner and operator of the Manufacturers' Representative Co., Pittsburgh, and secretary of the American Drop Forging Institute, died on Dec. 1 at his home in that city.

MAGNUS S. COOK, Orange, N. J., died on Nov. 19 of a heart attack. He was a retired hydraulic engineer and had been connected with the Otis Elevator Co. for 36 years.

DAVID C. KLAUSMEYER, assistant general manager of the Cincinnati Bickford Tool Co., Cincinnati, Ohio, died on

Dec. 6 at Cincinnati. He had worked his way up from the drafting room to his present position in charge of production. He was 47 years of age.

ERIC WOLFF, designer of Corliss engines and power plants for the Allis-Chalmers Manufacturing Co., Milwaukee, died on Nov. 24 from heart trouble.

G. ARTHUR TIMBLE, 51, executive in a number of agricultural machinery companies, died on Nov. 25 at Evansville, Indiana.

OSCAR L. ANDERSON, president of O. L. Anderson, Inc., Detroit, died recently in that city at the age of 45 years.

GEORGE G. HARVEY, 57, president of A. Harvey Sons Manufacturing Co., Detroit, died in that city on Nov. 18.

FRED PRICE, 64, chief of car service of the Canadian National Railways, died on Dec. 2 in Chicago.

Forthcoming Meetings

STEEL FOUNDERS' SOCIETY OF AMERICA—Regular meeting, Pittsburgh, Pa., Dec. 12. Details may be obtained from the executive offices, 932 Graybar Bldg., New York City.

AMERICAN ENGINEERING COUNCIL—Annual Meeting, Washington, D. C., Jan. 9 to 11. L. W. Wallace, 26 Jackson Place, Washington, is secretary.

AMERICAN SOCIETY OF STEEL TREATERS—Semi-annual meeting, Hotel Pennsylvania, New York City, Feb. 7 and 8, 1930. W. H. Eisenman, 7016 Euclid Ave., Cleveland, is secretary.

THE WEEKLY PRICE GUIDE . . .

Rise and Fall of the Market

BUYING of steel by railways continues brisk in view of the fact that authorized programs of improvement and capital expenditure now under way, are greater than in any similar period during the last five years. At least 35 per cent of this money ($370,000,000) will be spent for equipment. There is also noticeable acceleration of demand for steel material in the automotive industry. Galvanized steel sheets are down 10c. per 100 lb., to $3.40, minimum, base, Pittsburgh, compared with prices of a week ago. Non-ferrous materials and supplies have recovered very slightly from the price declines of recent weeks. Roll sulphur, solder, babbitt, and scrap non-ferrous metals are higher than a week ago.

(All prices as of Dec. 6, 1929)

IRON AND STEEL

PIG IRON—Per gross ton, f.o.b:

CINCINNATI	
No. 2 Southern (silicon 1.75@2.25)	$17.69@$18.19
Northern Basic	19.90
Southern Ohio No. 2	19.90
NEW YORK—Tidewater Delivery	
No. 2 Southern (silicon 1.75@2.25)	19.50
BIRMINGHAM	
No. 2 Foundry (silicon 1.75@2.25)	14.00@14.50
PHILADELPHIA	
Eastern Pa., No. 2x (silicon 2.25@2.75)	21.76@22.26
Virginia No. 2	24.04
Basic	19.75@20.25
CHICAGO	
No. 2 Foundry, local (silicon 1.75@2.25)	20.00
No. 2 Foundry, Southern (silicon 1.75@2.25)	20.01
PITTSBURGH, including freight charge ($1.76) from Valley:	
No. 2 Foundry	20 26
Basic	20.26
Bessemer	20.76

IRON MACHINERY CASTINGS—Cost in cents per lb. of 100 flywheels, 6-in. face x 24-in. dia., hub not cored, good quality gray iron, weight 275 lb:

Detroit	4.50
Cleveland	5.00
Cincinnati	4.50
New York	5.25
Chicago	4.50@4.75

SHEETS—Quotations are in cents per pound in various cities from warehouse; also the mill base in large lots:

Blue Annealed*	Pittsburgh Mill Base	Chicago	Cleveland	New York
No. 10	2.10@2.20	3.35	3.30	3.90†
No. 12	2.15@2.25	3.45	3.35	3.95†
No. 14	2.25@2.35	3.55	3.45	4.00†
No. 16	2.35@2.45	3.65	3.55	4.10†
Black				
Nos. 18 to 20	2.55	3.85	3.70	3.80
No. 22	2.70	4.00	3.85	3.95
No. 24	2.75	4.05	3.90	4.00
No. 26	2.85	4.15	4.00	4.10
No. 28	3.00	4.75	4.15	4.25
Galvanized				
No. 10	2.70@2.80	4.20	4.05	4.05
Nos. 12 to 14	2.80@2.90	4.30	4.15	4.15
No. 16	2.90@3.00	4.40	4.25	4.25
No. 18	3.05@3.15	4.55	4.40	4.40
No. 20	3.20@3.30	4.70	4.60	4.55
No. 22	3.25@3.35	4.75	4.65	4.60
No. 24	3.40@3.50	4.90	4.75	4.75
No. 26	3.65@3.75	5.15	5.00	5.00
No. 28	3.90@4.00	5.40	5.25	5.25

*Light plates. †Up to 3,999 lb.

WELDED STEEL PIPE—Warehouse discounts are as follows:

	New York		Cleveland		Chicago	
	Black	Galv.	Black	Galv.	Black	Galv.
1 to 3 in. butt	53.74%	41.2%	55.5%	43.5%	55.5%	42.5%
3½ to 6 in. lap	50.32%	37.78%	53.5%	40.5%	51.6%	39.0%

WROUGHT-STEEL PIPE LIST

Size, Inches	List Price per Foot	Diameter in Inches—External	Diameter in Inches—Internal	Thickness Inches
1	$0.17	1.315	1.049	.133
1¼	.23	1.66	1.38	.14
1½	.27½	1.9	1.61	.145
2	.37	2.375	2.067	.154
2½	.58½	2.875	2.469	.203
3	.76½	3.5	3.068	.216
3½	.92	4.0	3.548	.226
4	1.09	4.5	4.026	.237
5	1.48	5.563	5.047	.258
6	1.92	6.625	6.065	.28
8	2.50	8.625	8.071	.277

SEAMLESS STEEL TUBING—Following net prices are for seamless mechanical tubing, cold drawn, round, .10 to .30 carbon, at New York warehouse in lots of less than 100 ft. or 100 lb:

Thickness—B.w.g. and Decimal Fractions		Outside Diameter in Inches—Price per Foot: ½	⅝	¾	⅞	1	1⅛	1¼
.035"	20	$0.15	$0.16	$0.17	$0.18	$0.19	$0.21	$0.23
.049"	18	.17	.18	.19	.20	.21	.23	.25
.065"	16	.19	.20	.21	.22	.23	.25	.27
.083"	14	.20	.22	.23	.24	.25	.27	.29
.095"	13	.21	.23	.25	.26	.27	.29	.31
.109"	12	.22	.24	.26	.27	.28	.30	.32
.120" or .125"	11	.23	.25	.27	.28	.29	.31	.33
.134"	10	.24	.26	.28	.29	.30	.32	.34

MISCELLANEOUS—Warehouse base prices in cents per lb:

	New York	Cleveland	Chicago
Spring steel, light*	4.50	4.65	4.65
Spring steel, heavier	4.00	4.00	4.00
Coppered Bessemer rods	6.05	6.00	6.20
Hoop steel	4.25†	4.00	4.15
Cold rolled strip steel	6.25	6.00	6.10
Floor plates	5.10†	5.30	5.00
Cold drawn, round or hexagon‡	3.50	3.65	3.60
Cold drawn, flat or square‡	4.00	4.15	4.10
Structural shapes	3.30†	3.00	3.10
Soft steel bars	3.25†	3.00	3.00
Soft steel bar shapes	3.25†	3.00	3.00
Soft steel bands	3.75†	3.65	3.65
Tank plates	3.30†	3.00	3.10
Bar iron (2.75 at mill)	3.25	3.00	3.00
Drill rod (from list)	60%	55%	50%

*Flat, $\frac{3}{16}$-in. thick. †Up to 3,999 lb., ordered and released for shipment at one time. ‡Cold finished steel, shafting and screw stock.

Electric welding wire at New York warehouse— $\frac{5}{32}$, 8.35c. per lb.; $\frac{1}{8}$, 7.85c. per lb.; $\frac{5}{32}$ to $\frac{1}{4}$, 7.35c. per lb.

METALS

Warehouse Prices in Cents Per Pound for Small Lots:

Copper, electrolytic, New York			19.25
Tin, Straits, pigs, New York			43.00@44.00
Lead, pigs, E. St. Louis	6.10	New York	7.00@ 7.50
Zinc, slabs, E. St. Louis	6.00	New York	7.25@ 7.75

	New York	Cleveland	Chicago
Antimony, slabs	10.50@11.00	11.60	14.50
Copper sheets, base	27.75	27.75	27.75
Copper wire, mill, base	20.12½	20.12½	20.12½
Copper, drawn, round, base	26.25	26.25	26.25
Copper tubing, base	29.25	29.25	29.25
Brass sheets, high, base	23.25	23.25	23.25
Brass tubing, high, base	28.25	28.25	28.25
Brass rods, high, base	21.25	21.25	21.25
Brass wire, high, base	23.75	23.75	23.75

SHOP MATERIALS AND SUPPLIES

METALS—Continued

	New York	Cleveland	Chicago
Aluminum ingots, 99%.....	25@26	24.30	24.30
Zinc sheets (casks).....	10.75@11.25	12.25	10.11
Solder (½ and ½).....	30.25	29.75	28@30
Babbitt metal, delivered in case lots, New York, cents per lb:			
Genuine, highest grade.....			58.00
Commercial genuine, intermediate grade.....			42.00
Anti-friction metal, general service.....			31.00
No. 4 babbitt.....			11.50

NICKEL AND MONEL METAL—Price in cents per lb., base, f.o.b. Huntington, W. Va:

	Nickel	Monel Metal
Sheets, full finished.....	52.00	42.00
Sheets, cold rolled.....	60.00	50.00
Strip, cold rolled.....	55.00	45.00
Rods, hot rolled.....	45.00	35.00
Rods, cold drawn.....	53.00	40.00
Tubing	75.00*	90.00†
Angles, hot rolled.....	50.00	40.00
Plates.....	52.00	42.00

*Seamless. †Welded.

OLD METALS—Dealers' purchasing prices in cents per pound, f.o.b. cars:

	New York	Cleveland	Chicago
Crucible copper.....	14.25 @14.75	13.50	12.00 @12.50
Copper, heavy, and wire..	14.00 @14.25	13.00	11.00 @12.00
Copper, light, and bottoms	12.00 @12.25	12.00	10.00 @11.00
Heavy lead.....	4.75 @ 5.00	5.25	4.25 @ 4.75
Tea lead.....	2.87½@ 3.12½	3.25	3.25 @ 3.75
Brass, heavy, yellow.....	7.75 @ 8.00	8.00	7.00 @ 7.50
Brass, heavy, red.....	11.00 @11.50	12.50	10.00 @10.50
Brass, light.....	6.75 @ 7.00	7.00	6.00 @ 6.50
No. 1 rod, brass turnings.	9.00 @ 9.25	8.00	7.50 @ 8.00
Zinc.....	3.00 @ 3.25	3.00	2.50 @ 3.00

TIN PLATES—Charcoal—Bright—Per box:

	New York	Cleveland	Chicago
"AAA" Grade:			
IC, 14x20.....	$12.10	$11.95	$11.50
"A" Grade:			
IC, 14x20.....	9.70	9.90	9.50
Coke Plates—Primes—Per box:			
100-lb., 14x20.....	6.45	6.10	7.00
Terne Plates—8-lb. Coating—Small lots—Per box:			
IC, 14x20.....	7.75@8.00	7.00	7.50

MISCELLANEOUS

	New York	Cleveland	Chicago
Cotton waste, white, per lb..	$0.13*	$0.16	$0.15
Cotton waste, colored, per lb..	.09½*	.12	.12
Wiping cloths, washed, white, per lb.....	.12½	38.00 per M	.16
Sal soda, per lb.....	.02½	.02	.02
Roll sulphur, per lb.....	.028	.03½	.04
Linseed oil, raw, in 1 to 4 bbl. lots, per lb.....	.152	.164	.16
Cutting oil, about 25% lard, in 5 gal. cans, per gal.....	.65	.60	.65
Machine oil, medium-bodied (55 gal. steel bbl.) per gal..	.33	.36	.24
Belting — Present discounts from list in fair quantities (½ doz. rolls) for leather or rubber:			
Leather—List price, 24c. per lin. ft., per inch of width, for single ply:			
Medium grade.....	30–10%	30–10%	35%
Med. grade, heavy wgt..	30%	30– 5%	30%
Rubber transmission, 6-in., 6 ply, $1.83 per lin.ft:			
First grade.....	50%	50–10%	50%
Second grade.....	60%	60– 5%	50–10%

*Grade F.

Comparative Warehouse Prices

New York	Unit	Current Price	Four Weeks Ago	One Year Ago
Soft steel bars.....	per lb..	$0.0325	$0.0325	$0.0325
Cold drawn shafting...	per lb..	.035	.036	.034
Brass rods.....	per lb..	.2125	.2125	.1825
Solder (½ and ½).....	per lb..	.3025	.3075	.3575
Cotton waste, white...	per lb..	.13	.13	.10@.13½
Disks, aluminum oxide mineral, cloth, No. 1, 6-in. dia.....	per 100.	4.59	4.60	3.59
Lard cutting oil.....	per gal.	.65	.65	.65
Machine oil.....	per gal.	.33	.33	.30
Belting, leather, medium.....	off list..	30–10%	30–10%	30–10%
Machine bolts, up to 1x30 in., full kegs...	off list..	50-10%*	50–10%*	50%*

*List prices as of April 1, 1927.

MISCELLANEOUS—Continued

	New York	Cleveland	Chicago
Abrasive materials — Standard grade, in sheets 9x11 in., No. 1, per ream of 480 sheets:			
Flint paper*.....	$6.03	$5.94	$5.94
Emery cloth*.....	25.87	26.40	26.40
Disks, aluminum oxide mineral, 6 in. dia., No. 1, per 100:			
Paper†.....	2.61	2.61	2.61
Cloth†.....	4.59	4.59	4.59
Fire clay, per 100 lb. bag.....	1.00	.75	.75
Coke, prompt furnace, per net ton.....		Connellsville,	2.65
Coke, prompt foundry, per net ton.....		Connellsville,	3.50@4.85
White lead, dry.....	100 lb. kegs ...	New York,	13.75
White lead, in oil.....	100 lb. kegs....	New York,	14.25
Red lead, dry.....	100 lb. kegs....	New York,	13.75
Red lead, in oil.....	100 lb. kegs....	New York,	15.25

*Less than 3 reams. †Less than 200.

SHOP SUPPLIES

Discounts from new list dated Apr. 1, 1927, applying on immediate deliveries from warehouse stocks in New York and vicinity:

Machine bolts:	
Up to ¾-in. x 6-in., full kegs, list less.....	60%
Larger, up to 1 x 30-in., full kegs, list less.....	50–10%
Less than full kegs or case lots, add to list.....	10%
Fitting-up bolts: list less.....	45%
Lag screws:	
Up to ½-in. x 6-in., list less.....	60%
Larger, list less.....	50–10%
Less than full keg or case lots, add to list.....	10%
Rivets:	
Structural, round head, full kegs, net.....	$4.50
Structural, round head, broken kegs, net.....	6.00
Tank, $\frac{7}{16}$-in. dia. and smaller, list less.....	60%
Nuts:	
Hot pressed, square or hexagonal, blank or tapped:	
Full kegs up to 1-in., incl., list less.....	60%
Larger, up to 3-in., list less.....	40–10%
Less than keg or case lots, add to list.....	10%
Washers:	
Wrought, full kegs, per 100 lb., list less.....	$4.00
Wrought, broken kegs, per 100 lb., list less.....	2.00
Turnbuckles:	
With stub ends, list less.....	20%
Without stub ends, list less.....	50%
Chain:	
Proof coil, base, per 100 lb., net.....	$7.10
Cast iron welding flux, per lb., net.....	.40
Brazing flux, per lb., net.....	.80

MACHINE REQUIREMENTS AND INDUSTRIAL CONSTRUCTION

Equipment Wanted

Mass., Jamaica Plain—P. O. Box No. 25—greasing machine, electric drill valve refacer, battery recharger and other equipment.

Mass., Wakefield—Neveroil Bearing Co.—35-50 ton hydraulic or power driven arbor press, not less than 15 in. stroke.

Mich., Detroit—Majestic Tool & Mfg. Co., 2650 Poplar St. (light metal manufacturing)—grinder and equipment for general use.

Mich., Monroe — Detroit Stoker Co., 3-120 General Motors Bldg., Detroit—miscellaneous equipment for the manufacture of stoker parts for proposed 1 story, 60 x 180 ft. factory here. Estimated cost $40,000.

Mo., Valley Park—Barbour Boat Works—angle shear, hand or power, 2 x 2 x 5.16 capacity, also power punch or punch press ¾ through ¾ capacity.

Tex., Prairie View—Prairie View College—complete equipment and tools for wood work, drawing, iron work, etc., for proposed 1 and 2 story mechanical engineering shop. Plans under way by F. E. Giesecke, College Station, College Archt. $100,000.

Wis., Chippewa Falls—County Board, W. H. Taylor, Comr.—appropriated $4,700 for machine shop equipment.

Opportunities for Future Business

Ark., Russellville — Chamber of Commerce, c/o E. W. Hogan, Pres., is having preliminary plans prepared for the construction of an airport development to include hangars, shops, etc.

Calif., Oakland—A. Cords, 2822 Park Blvd., is having plans prepared for the construction of a 100 x 100 ft. garage and service station on Park Blvd. Private plans.

Conn., Hamden—New Haven Road Construction Co. Inc., 70 College St., awarded contract for the construction of an engineering and utility building on Dixwell St. Estimated cost $42,000. Noted Nov. 7.

Conn., Middletown—Wilcox Crittenden & Co., Inc., 3 South Main St., will soon award contract for the construction of a 1 and 2 story, 100 x 190 ft. foundry and 25 x 45 ft. boiler house at Pameacha Ave. and High St. Estimated cost to exceed $40,000. Lockwood Greene Engineers Inc., 24 Federal St., Boston, Mass., Engrs. Noted Nov. 28.

Conn., New Haven—G. & O. Mfg. Co., 138 Winchester Ave., is receiving bids for the construction of a 2 story, 40 x 100 ft. factory for the manufacture of airplane radiators on Winchester Ave. Estimated cost $40,000. Westcott & Mapes, 139 Orange St., Archts.

Ill., Mount Carmel—Lincoln Foundry Co., c/o A. L. Richmond, Pres. Chamber of Commerce, awarded contract for the construction of a 1 story foundry. Estimated cost $40,000.

Ind., Fort Wayne—Fort Wayne Milling Co., awarded contract for the construction of a 60 x 250 ft. rolling mill plant at 1701 McKinley St. Estimated cost $50,000.

Ind., Mishawaka — Duratile Corp., awarded contract for the construction of a 50 x 100 ft. factory at 227 North Mill St. Estimated cost $43,000.

Mass., Boston—Schoolhouse Dept., awarded contract for addition to elementary school, including shops, etc., at North End Section. Estimated cost $250,000.

Mass., Brighton (Boston P. O.)—The Heil Co., 140 Brookline Ave., Cambridge, awarded contract for the construction of a 1 story, 60 x 105 ft. garage and repair shop here. Estimated cost $40,000.

Mass., Chicopee—C. F. Church Mfg. Co., G. W. Carlson, Mgr., Holyoke, manufacturers of bathroom fixtures, awarded contract for addition and alterations to factory on Montgomery St. Estimated cost $40,000.

Mass., Gloucester—City, plans the construction of an airport, including hangars, shop, etc. Estimated cost $25,000. J. J. Griffin, City Hall, Engr.

Mass., Malden (Boston P. O.)—Malden Machine Tool Co., 158 Exchange St., is receiving bids for the construction of a 1 story, 60 x 100 ft. machine shop on Abbott Rd. Estimated cost $40,000. C. F. Springall, 50 Park St., Archt. Former contract rescinded. Noted Oct. 17 under W. E. Arnold Co., 17 Centre St.

Mass., Pittsfield—Orr Motor Co., 104 South St., is receiving bids for the construction of a 2 story repair and service garage on Elm and East Sts. J. McArthur Vance, 24 North St., Archt. Noted Nov. 14.

Mass., Roxbury (Boston P. O.)—J. J. O'Connell, 78 Fisher Ave., awarded contract for the construction of an auto radiator repair shop at 1322 Columbus Ave.

Mass., Waltham (Boston P. O.)—M. Sullivan, 1025 Main St., awarded contract for the construction of a 1 story repair and service garage. Estimated cost $40,000. Noted Oct. 31.

Mass., West Roxbury (Station P. O.) — H. Gernor, 275 Grove St., will build a 2 story monument shop and garage on Grove St. Private plans.

Mich., Coldwater — Homer Furnace Co., is having plans prepared for the construction of a 1 story furnace factory. Estimated cost $150,000. Private plans.

Mich., Detroit—Bellevue Industrial Furnace Co., 2971 Bellevue Ave., is having plans prepared for the construction of a 1 story, 85 x 165 ft. factory for the manufacture of industrial furnaces. Estimated cost $45,000. C. L. Phelps, 503 Detroit Savings Bank Bldg., Archt.

Mich., Detroit—C. W. Brandt, 2111 Woodward Ave., Archt., will receive bids about Dec. 19 for the construction of a 1 story, 60 x 400 ft. steel mill on Tireman Ave. for Bopp Steel Co., 4-237 General Motors Bldg.

Minn., St. Paul—City will soon award contract for the construction of a 2 story hangar, including garage, shops, etc., at municipal airport.

Mo., Kansas City—Missouri Pacific Ry. Co., Railway Exchange Bldg., St. Louis, plans the construction of engine terminal shops here. Estimated cost $750,000. E. A. Hadley, Ch. Engr.

Mo., St. Louis—Bd. of Education, 911 Locust St., will receive bids in January or February for the construction of first unit of vocational school, 5 story, 188 x 275 and 160 x 230 ft., including shops, etc. Estimated cost $1,500,000. C. W. Sanger, Acting Building Comr.

Mo., St. Louis—Johnston Tin Foil & Metal Co., 6106 South Broadway, is having preliminary plans prepared for a 2 story, 100 x 104 ft. addition to factory. C. H. Deiterling, 1320 Central National Bldg., Archt.

N. J., Manville—Johns-Manville Corp., Madison Ave. and 41st St., New York, N. Y., will build a 250 x 600 ft. factory for the manufacture of asbestos products, here. Estimated cost $150,000. Wigton Abbott Corp., 552 West 23rd St., New York, N. Y., Archts. Noted Nov. 21.

N. J., Newark—Siegler & Greenberg, 164 Market St., Archts., will receive bids about Mar. 1 for the construction of a 6 story, 68 x 120 ft. radio tube factory at 78-82 8th Ave., for Sonatron Tube Co., 57 State St. Estimated cost $175,000. Noted May 24.

N. Y., Brooklyn—J. Cervonsky, c/o M. Klein, 65 Court St., Archt., will soon receive bids for the construction of a 176 x 200 ft. garage at Heyward St. and Harrison Ave. Estimated cost $100,000. Noted Nov. 28.

N. Y., Brooklyn—M. Cohen, 50 Court St., plans the construction of a 2 story, 100 x 208 ft. garage at 88th St. and 4th Ave. Estimated cost $60,000. P. Freshman, 50 Court St., Archt.

N. Y., Brooklyn — B. Kugler, 1053 Ocean Parkway, will receive bids about Feb. 1 for the construction of a garage at Quentin Rd. and Coney Island Ave. Estimated cost $150,000. I. Kallich, 26 Court St., Archt. Noted Oct. 31.

N. Y., Brooklyn—T. Murcott, 298 Union Ave., plans the construction of a 2 story, 120 126 ft. factory for the manufacture of files at 15th St. and Wythe Ave. Estimated cost $50,000. Tillion & Tillion, 415 Lexington Ave., Archts.

N. Y., Brooklyn—W. H. Nicholls, 91st Ave. and 126th St., Richmond Hill, plans the construction of a 5 story, 77 x 82 ft. garage at College Pl. and Love Lane. Estimated cost $80,000. Slee & Bryson, 160 Montague St., Archts.

N. Y., Brooklyn—St. Johns Place Corp., P. Siegler, Pres., 531 Rockaway Ave., plans the construction of a 2 story, 162 x 225 ft. garage at St. Johns Pl. and Classon Ave. Estimated cost $150,000. M. J. Ort, 424 East 149th St., New York, Archt.

N. Y., Brooklyn—U. S. Trucking Corp., 17 Battery Pl., New York, plans the construction of a 1 story, 78 x 99 ft. garage and shop at Fulton and Hicks Sts., here. Estimated cost $40,000. L. A. Sheinart, 194 Bowery, New York, Archt.

N. Y., Elmhurst—J. Gerard, 80-15 45th Ave., Long Island City, plans the construction of a 1 story, 141 x 180 ft. garage at 82nd St. and 45th Ave. Estimated cost $40,000. P. Coco, 433 Steinway Ave., Astoria, Archt.

N. Y., Flushing—Firestone Tire & Rubber Co., 70 West End Ave., New York, awarded contract for the construction of a service and repair shop at 155th St. and North Blvd., here. Estimated cost $40,000.

N. Y., Forest Park—Dept. of Parks, New York, plans the construction of two 1 story, 31 x 115 ft. service buildings at 88th Pl. and Myrtle Ave. Estimated total cost $60,000. A. Grande, Forest Park, Archt.

N. Y., Long Island City—Rubel Corp., 937 Fulton St., Brooklyn, plans the construction of a 1 story, 104 x 182 ft. garage at Wierfield St. and Seneca Ave. Estimated cost $40,000. H. Muriel, c/o owner, Archt.

N. Y., New York—Battery Operating Co., S. Inger, Pres., 49 West 66th St., plans the construction of a 6 story garage. Estimated cost $70,000.

N. Y., New York — Three Hundred Fifty Seven East 76th St. Corp., J. Ruth, Pres., will build a 6 story garage. Estimated cost $225,000. G. G. Miller, 1482 Broadway, Archt. Noted Feb. 21.

O., Cleveland — Hammond Mfg. Co., C. M. Allen, Pres., 7808 Kinsman Rd., had plans prepared for the construction of a 1 story, 75 x 124 ft. factory at 3889 East 80th St. Estimated cost $50,000. H. M. Morse Co., Finance Bldg., Archt.

O., Dayton—Brownell Co., 204 North Findley St., plans a 2 story addition to factory for the manufacture of boilers and stokers on Findlay St. Estimated cost $500,000. Geyer & Neuffer, Ludlow Arcade, Archt.

O., Elyria—Timms Spring Co., plans the construction of a 1 story factory at Boston and Taylor Sts. Estimated cost $40,000 to $50,000. Private plans.

O., Youngstown — Carnegie Steel Co., Ohio Works, plans the construction of a 10 in. bar mill at McDonald plant, also enlarging capacity of 12 in. mill at upper Union plant. Estimated cost $3,000,000. Private plans.

Pa., East Pittsburgh—Westinghouse Electric & Mfg. Co., E. M. Herr, Pres., awarded contract for the construction of an 11 story central engineering laboratory. Estimated cost $300,000. B. H. Prack, Martin Bldg., N. S. Pittsburgh, Archt.

Pa., Philadelphia — Gimbel Bros., 9th and Market Sts., will receive bids about Jan. 2 for the construction of a 2 story garage and shop at Hamilton and 21st Sts. Estimated cost $175,000. Abbott Merkt & Co., 178 5th Ave., New York, N. Y., Archts. Former bids rejected. Noted Nov. 21.

Pa., Pittsburgh—Aluminum Co. of America, Oliver Bldg., plans to expend $50,000,000 in 1930. Allocation under the budget heading has not been completed but a considerable portion of this sum will be spent in Pittsburgh district.

Ont., Sault Ste. Marie — Fitzgerald Laboratories, Niagara Falls, N. Y., manufacturers of ferro alloy, will build a plant to include two furnaces on Hudson St. Estimated cost $100,000.